

JE
453
A5
1909

DRILL REGULATIONS
FOR
COAST ARTILLERY
UNITED STATES ARMY
—
1909

453

A5

1909

Cornell University Library

FROM THE

UNITED STATES GOVERNMENT

THROUGH THE

SUPERINTENDENT OF DOCUMENTS

#238945

12/11/09

§ 506 Rev. Stat. prohibits the withdrawal of this book for home use.

Cornell University Library
UF453 .A5 1909

Coast artillery drill regulations, Unite



3 1924 030 759 579

olin



Cornell University
Library

The original of this book is in
the Cornell University Library.

There are no known copyright restrictions in
the United States on the use of the text.

<http://www.archive.org/details/cu31924030759579>

COAST ARTILLERY
DRILL REGULATIONS
UNITED STATES ARMY

1909



WASHINGTON : GOVERNMENT PRINTING OFFICE : 1909

~~4312~~ 26
~~D26a~~

A.238945
WAR DEPARTMENT.

Document No. 343.

Office of the Chief of Coast Artillery.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, April 14, 1909.

The following Coast Artillery Drill Regulations have been approved by the President and are published for the information and government of the Army of the United States and for observance by the organized militia of the United States.

By order of the Secretary of War :

J. FRANKLIN BELL,
Major-General, Chief of Staff.

CONTENTS.

	Page.
CHAPTER I.	
General principles	9-11
CHAPTER II.	
Definitions	12-28
CHAPTER III.	
Organization	29-32
CHAPTER IV.	
Marching maneuvers	33-36
To form the company	33-35
To march to the battery	35
To post the sections	35-36
CHAPTER V.	
The battery—General duties	37-40
CHAPTER VI.	
Service at the emplacements	41-104
General instructions	41-43
Mortar battery	43-53
12-inch gun battery, disappearing carriages	53-67
10-inch gun battery, disappearing carriages	67-74
8-inch gun battery, disappearing carriages	74
6-inch gun battery, disappearing carriages	74-80
12-inch gun battery, barbette carriages	81-89
10-inch gun battery, barbette carriages	89
8-inch gun battery, barbette carriages	89-90
6-inch gun battery, pedestal mount	90-95
5-inch, 4.7-inch, and 4-inch gun battery	96
3-inch gun battery	96-100
6-pounder gun battery	100-104
CHAPTER VII.	
Battery fire-control	105-112
Gun battery of the primary armament	105-109
Mortar battery	109-112
Battery of the intermediate armament	112
Battery of the secondary armament	112

CHAPTER VIII.

	Page.
Bore sighting, orientation, and pointing.....	113-117
Bore sighting and orientation.....	113-114
Methods of pointing.....	114-115
Pointing tests.....	115-117

CHAPTER IX.

Fire and mine commands.....	118-122
The fire command.....	118-120
Fire-control system of a fire command.....	120-121
The mine command.....	121-122
Fire-control system of a mine command.....	122

CHAPTER X.

The battle command.....	123-125
The battle command.....	123-125
Fire-control system of a battle command.....	125

CHAPTER XI.

The artillery district.....	126-129
-----------------------------	---------

CHAPTER XII.

The post.....	130-133
---------------	---------

CHAPTER XIII.

An artillery inspection.....	134-135
------------------------------	---------

CHAPTER XIV.

Target practice and salutes.....	136-143
Subcaliber practice.....	136-137
Service practice.....	137-139
Battery service practice.....	139-141
Fire command service practice.....	141-142
Battle command service practice.....	142
Modification of practice regulations.....	142
Reports of target practice.....	142
Salutes.....	143

CHAPTER XV

Night drill—Searchlights.....	144-148
Night drill.....	144
Searchlights.....	144-148

CHAPTER XVI.

	Page.
Communications	149-153

CHAPTER XVII.

Fire-control apparatus	154-173
Atmosphere board	154
Anemometer	154
Azimuth instrument	154-156
Barometer	156
Deflection board	156-158
Depression position finder	159-161
Mortar deflection board	161
Plotting board	161-163
Powder chart	163-164
Range board	165-170
Telescope	170-171
Telescopic sight	171
Thermometer	171-172
Wind-component indicator	172
Wind vane	172-173

CHAPTER XVIII.

Care of material	174-192
------------------------	---------

CHAPTER XIX.

Storage and handling of explosives	193-200
General instructions	193-194
Commercial detonators	194-195
Dynamite	195-196
Explosive D	196-197
Fuses and primers	197
Gun cotton	197-199
Smokeless powder	199-200
Projectiles, filled and fused	200

CHAPTER XX.

Examination for gunners and for special ratings	201-207
Instruction of gunners	201-203
Qualification of rated enlisted men	203-207

COAST ARTILLERY DRILL REGULATIONS, UNITED STATES ARMY.

CHAPTER I.

GENERAL PRINCIPLES.

1. Coast defense comprises the military and naval dispositions and operations to resist an attack by sea on a coast line. Such attack may take the form of a naval attack, a land attack, or a combined naval and land attack.

2. In the defense of a coast line the functions of the naval forces are normally offensive; those of the land forces, defensive. The operations of the naval forces may be and usually are conducted at a distance from the coast line being defended; those of the land forces are confined to that coast line. Such portions of the naval forces, however, as are not included in the sea-going fleet may be assigned to assist the military forces in the local defense of important harbors. Vessels so assigned are designated as floating defenses, and may include ships of the line, monitors, scouts, torpedo boats, submarine boats, patrol boats, and picket boats.

3. The military preparations for the defense of a coast line usually include—

(1) The construction of permanent fortifications and the provision of submarine defenses, manned by coast-artillery troops, for the defense against naval attack of those harbors that are of commercial or strategic importance. For the protection of the permanent fortifications against capture by small raiding parties landed from an attacking fleet field works are constructed and small bodies of mobile troops assigned thereto. Troops assigned to this duty are designated as "Coast artillery supports."

(2) The assignment of troops of the mobile army for the local defense against land attack of those harbors that are of commercial or strategic importance, and the construction for use in such defense of semi-permanent fortifications or field works. Troops assigned to this duty are designated as the "Coast guard."

(3) The mobilization and organization of troops of the mobile army into field armies at points strategically located with respect to the entire coast line.

4. The permanent fortifications consist usually of works constructed of earth and concrete with armament mounted therein in fixed positions, together with the accessories necessary for the effective service of this armament. The submarine defenses consist of submarine mines, automobile torpedoes, and marine obstructions.

5. The armament of the permanent fortifications is classified as primary, intermediate, and secondary. Guns of the intermediate and secondary armament are called rapid-fire guns.

6. The primary armament consists of guns of 8-inch and larger caliber, and 12-inch mortars. These guns and mortars are used to attack armored vessels with shot and shell carrying high explosives. Shell are used at the longer ranges to penetrate thin armor, to silence the secondary batteries, to injure vessels by racking effect, and to demolish the fire-control stations at more than the battle ranges of naval ships. Shot are used at ranges where the perforation of main armor is possible and are intended to reach the vitals of a ship before explosion.

7. Mortars employ high-angle fire, and are used at all ranges to attack the decks of ships with high explosive shell.

8. The intermediate armament consists of 6-inch, 5-inch, and 4.7-inch guns. This armament is used primarily to attack unarmored vessels, but may be used effectively to supplement the primary armament in the attack of armored vessels or the secondary armament in the defense of the mine fields.

9. The secondary armament consists of 4-inch and 3-inch guns. It is used for the defense of the mine fields and to supplement the intermediate armament in the attack of unarmored vessels.

10. The multiplicity of calibers is the result of gradual development rather than of design. The typical guns of the different classes are as follows:

Primary: 12-inch or larger guns, 12-inch mortars.

Intermediate: 6-inch guns.

Secondary: 3-inch guns.

11. For the effective service of the armament the following are necessary:

(a) Ammunition, sights, quadrants, loading implements.

(b) Fire-control equipment.

(c) Power and light equipment.

(d) Wireless and other methods of long-distance communication.

12. The units of the tactical chain of coast artillery command are:

The battery.

The fire command.—The mine command.

The battle command.

The district command.

13. **A battery** is a number of guns or mortars of the same caliber and power, grouped with the object of concentrating their fire upon a single target and of being directly commanded in action by a single individual. The term is used to include also the emplacements in which the guns are mounted and, in a more general sense, the personnel and accessories required to operate it.

14. Batteries are named usually for deceased officers who were killed in action or who were connected with the construction of fortifications or the construction and service of their armament. For example: "Battery Shipp," "Battery Parrot," "Battery De Russy," "Battery Barry."

15. **A fire command** is a group of batteries, generally not more than four, organized for command by a single individual. The batteries composing a fire command should be situated so that their fire covers the same or contiguous water areas.

16. Where it can be avoided, primary, intermediate, and secondary armaments are not grouped in the same fire command, nor are gun and mortar batteries so combined.

17. **A mine command** consists of the mine groups and the rapid-fire batteries specifically assigned for their protection which are designated for control by a single individual.

18. **A battle command** consists of all fire and mine commands which may be controlled advantageously by one man in the defense of a harbor. Battle, fire, and mine commands are designated by number.

19. **A district command** consists of those battle commands which are within supporting distance of one another, together with the coast artillery supports assigned to the district. For administrative purposes, forts not within supporting distance may be included in the district.

20. Districts are designated by name, as "The Southern Artillery District of New York."

CHAPTER II.

DEFINITIONS.

21. Aiming.—Pointing the gun by means of a sight. (See Pointing.)

22. Ammunition hoist.—The device by means of which ammunition is raised to the loading platform. Separate hoists are used for projectiles and powder, or the latter is served by hand.

23. Ammunition recess.—The space in the parapet wall for the temporary storage of ammunition.

24. Angle of departure.—The angle between the line of departure and the line of sight.

25. Angle of fall.—The angle of fall is the angle which the tangent to the trajectory at the point of impact makes with the line of shot.

The angle of fall is often expressed as a slope; for example, 1 on 10.

26. Angle of impact.—The complement of the angle of incidence.

27. Angle of incidence.—The angle between the line of impact and the normal to the surface at the point of impact.

28. Angle of position (or depression).—The angle between the line of sight and a horizontal plane through the axis of the trunnions.

29. Apron.—That portion of the superior slope of a parapet or the interior slope of a pit, designed to protect the slopes against blast.

30. Approaches.—Roadways entering the battery parade.

31. Artillery engineer.—An officer at a coast fort who has charge of the maintenance of all power and electrical apparatus.

32. Atmosphere board.—A board for determining the atmosphere reference number. (See paragraphs 617, 749, and 750.)

33. Axis of gun.—The central line of the bore.

34. Axis of trunnions.—The central line of the trunnions.

35. Azimuth of a point.—In coast artillery, the horizontal angle measured in a clockwise direction from south to a line from the observer to the point. For example, the azimuth of a point B from A is the angle (measured clockwise from the south) between the north and south line through A and the line from A to B. The north point has an azimuth of 180° .

36. Azimuth difference.—The difference between the azimuths of a point as read from two other points.

37. Azimuth instrument.—An instrument for determining azimuths. (See paragraphs 753 to 755, inclusive.)

38. Azimuth setter.—The member of a mortar detachment who lays the mortar in azimuth.

39. Base end station.—An observing station at either end of a base line, designed to contain an azimuth instrument or depression position finder. Base end stations are designated as primary, secondary, or supplementary.

40. Base line.—A horizontal line the length and direction of which have been determined. This line is used in position finding, especially for long ranges; the stations at its ends are called "base end stations." It is called "right" or "left" handed, depending on whether the primary station is to the right or left of the secondary facing the field of fire.

41. Banquette.—The step between the truck and loading platforms.

42. Battery.—The entire structure erected for the emplacement, protection, and service of one or more guns or mortars, together with the guns or mortars so protected. The guns of a battery are grouped with the object of concentrating their fire on a single target and of their being commanded directly by a single individual.

43. Battery commander.—The senior artillery officer present for duty with a battery.

44. Battery commander's station.—An observing station at or near the battery, usually in rear of the center traverse.

45. Battery commander's walk.—The elevated walk leading from the battery commander's station along the rear of the battery.

46. Battery parade.—The area in rear of the emplacements where the sections form.

47. Battle area.—The area covered by the armament of a battle command.

48. Blast slope.—See Apron.

49. Blending.—The process of mixing powders of the same or different lots so as to obtain charges of uniform characteristics.

50. Bore. The interior of a cannon forward of the front face of the breechblock. It is composed of the powder chamber, the centering slope, the forcing cone, and the rifled portion called the "main bore."

51. Bore-sighting.—In coast artillery, the process by which the line of sight and axis of the bore prolonged are caused to converge on a point at or beyond mid-range. (See paragraph 526.)

52. Bourrelet.—A swell in the body of the projectile just in rear of the head.

53. Breech.—The mass of metal behind the plane of the bottom of the bore.

54. Breechblock.—The metal plug which closes the breech.

55. Breech mechanism.—The breechblock, obturating device, firing mechanism, and mechanism for operating the breechblock.

56. Breech recess.—The opening which receives the breech-block.

57. Breech reenforce.—The part of the cannon in front of the breech and in rear of the trunnion band.

58. Bursting charge.—The charge of explosive in a projectile.

59. Caliber of gun.—The diameter of the bore in inches, measured between diametrically opposite lands. It is the minimum diameter of the rifled portion of the gun.

60. Calibration.—Adjusting the range scale so that the range reading at any particular elevation of the gun will indicate the true distance to the center of impact of a group of shots fired from that particular gun and mount at that elevation with the standard velocity and under normal atmospheric conditions.

It is desirable to calibrate the guns of a battery under the same atmospheric conditions, although this is not absolutely necessary. It is absolutely necessary that uniform ammunition be used for calibration firing of all guns of a particular battery.

When the individual guns of a battery are calibrated the battery is calibrated, for the centers of impact of a series of shots from each gun under normal atmospheric conditions will coincide at the point indicated by any range setting.

When guns of a battery "shoot together" (that is, give the same range for the same range setting), they may be fired on the same data, but are not calibrated unless the range under normal atmospheric conditions is that indicated by the range setting.

It is not feasible to determine by actual firing all the points of a range scale, and therefore it is assumed that the gun is calibrated when a range scale constructed from a computed range table is adjusted on the gun so as to give the proper setting for a mid-range.

61. Cannon.—Artillery weapons from which projectiles are thrown by the force of expanding powder gases.

Cannon are of three classes: Guns, mortars, and howitzers.

Guns are long (generally 30–50 calibers), have flat trajectories, and are used for low-angle fire (less than 15°), with high velocities (2,000–3,000 f. s., about).

Mortars are short (about 10 calibers), and are used for high-angle fire (45° – 70°), with low velocities (550–1,300 f. s., about).

Howitzers are intermediate between guns and mortars.

The term "piece" is used when referring to a cannon of any class.

Cannon of the United States land service are classified according to their use into coast, siege, and field.

Cannon are made of a single piece or built up of two or more pieces.

62. Canopy.—The projecting roof over the delivery tables of ammunition hoists of gun batteries.

63. Capital.—The line through the gun pintle bisecting the arc of the interior crest.

64. Carriage or mount.—The means provided for supporting a cannon. It includes the parts for giving elevation and direction, for taking up the recoil on discharge, and for returning the piece to the firing position.

65. Carriage, fixed.—A mount provided for guns and mortars in permanent works and not designed to be moved from place to place.

66. Carriage, movable (wheeled mount).—A carriage or mount provided with wheels for transportation of the piece mounted thereon.

67. Carriages, coast.—Those used for coast artillery cannon. They may be divided into four classes, depending upon the nature of cover afforded by the emplacements:

(a) **Barbette:** Where the gun remains above the parapet for loading and firing.

(b) **Disappearing:** Where the gun is raised above the parapet for firing, and recoils under cover for loading.

(c) **Masking mount:** Where the gun remains above the parapet for loading and firing but can be lowered below the level of the crest for concealment.

(d) **Casemate:** Where the gun fires through a port.

If the carriage can be traversed so that the gun may be fired in all directions it is said to have all-round-fire (A. R. F.). If the carriage can not be traversed so that the gun may be fired in all directions, it is said to have limited fire (L. F.).

Rapid-fire gun carriages (except the 6-inch on disappearing carriage) are constructed so that the gun recoils in a sleeve and returns to the loading position immediately after firing.

Guns of the movable armament are mounted on wheeled carriages.

68. Case I—Case II—Case III.—(See Pointing.)

69. Casemate electrician.—The member of a mine command assigned to the care and operation of the mining casemate.

70. Charge.—The powder and projectile. The powder for large cannon to include 4.7-inch guns is separate from the projectile. For smaller calibers the projectile and powder are not separate; such ammunition is called "fixed."

71. Chase.—The part of the gun in front of the trunnion band.

72. Chief of ammunition service.—A noncommissioned officer in charge of the magazines, galleries, and service of ammunition for a gun battery, or a mortar emplacement.

73. Chief loader.—A noncommissioned officer of a mine company in charge of loading submarine mines.

74. Chief planter.—A noncommissioned officer of a mine company in charge of the service on a mine planter.

75. Clinometer.—An instrument for measuring accurately the inclination of the axis of the bore to the horizontal.

76. **Clinometer rest.**—The support for a clinometer inserted in the muzzle of the gun; also called "bore plug."

77. **Coast artillery fort.**—The coast defenses at any military post and the personnel assigned thereto.

78. **Coast artillery garrison.**—The personnel, to include regular coast artillery, coast artillery reserves, and coast artillery supports, assigned to a coast artillery fort.

79. **Coast artillery reserves.**—Troops of the organized militia organized as coast artillery for the purpose of supplementing the regular coast artillery in time of war.

80. **Coast artillery supports.**—Infantry troops assigned to coast artillery forts to support the artillery in repelling land attacks in the immediate vicinity of the fortifications.

81. **Communications.**—Means of transmitting orders and messages through the tactical chain of command. (See Chapter XVI.)

82. **Computer.**—A member of the fire-control section who operates a range or deflection board.

83. **Corrected range.**—The fictitious range which determines the elevation to be given the gun.

84. **Corridor.**—The passageway in rear of a traverse connecting two adjacent emplacements, at the loading platform level.

85. **Corridor wall.**—The traverse wall along the corridor.

86. **Counterweight.**—The weight used in bringing a gun on a disappearing carriage or masking parapet mount to the firing position. The pit in the gun platform for the reception of the counterweight of a disappearing carriage is called the counterweight well.

87. **Cover posts.**—Positions for the members of a mortar detachment at the command **TAKE COVER**.

88. **Crane.**—A mechanical device for raising ammunition by means of differential or other blocks.

89. **Danger space.**—The horizontal distance within which a target of a given height would be hit by a projectile. The danger space varies with the range, the flatness of the trajectory, the height of the target, and the height of the gun above the target.

The maximum range which is all danger space is called the "danger range."

90. **Deflection.**—The horizontal angle between the plane of sight and plane of departure; it is expressed as a **reference number**, and is set off on the sight deflection scale.

91. **Deflection board.**—A device for the purpose of determining the reference numbers for the deflection scale of the sight in Cases I and II, and the azimuth correction reference number in Case III; and, for mortars, the corrected azimuth. (See paragraphs 757 to 768, inclusive.)

92. **Delivery table.**—The table from which ammunition is delivered to the truck.

93. **Density of loading.**—The mean density of the whole contents of the powder chamber. It is the ratio of the weight

of the powder charge to the weight of a volume of distilled water (temperature of 39.2° F.) which will fill the powder chamber. The formula for computing it is

$$\Delta \text{ (density of loading)} = (27.7 W) / V,$$

in which W is equal to the weight of the powder in pounds and V the volume of the chamber in cubic inches.

94. Depression position finder.—An instrument to determine the range and azimuth of a target, the ranges corresponding to different angles of depression being indicated on the instrument. (See paragraphs 769 to 779, inclusive.)

95. Deviation.—Distances measured either in the horizontal plane at the level of the target or in a vertical plane through the center of the target at right angles to the plane of direction. If from the point of impact of a shot a perpendicular be drawn to the plane of direction, the length of this perpendicular is the lateral deviation, and it is plus or minus according as the point of impact is to the right or left of the line of direction looking from the gun. The distance from the foot of this perpendicular to the center of the target is the longitudinal deviation. It is plus when the point of impact is beyond the target, and minus when it is short.

96. Deviation at the target.—If from the target a line be drawn perpendicular to the plane of direction intersecting the plane containing the line of shot, the length of this perpendicular is the "deviation at the target."

97. Deviation, absolute.—The distance measured in a straight line from the center of the target to the point of impact.

98. Deviation, mean lateral.—The arithmetical mean of the lateral deviations of the points of impact of a series of shots.

99. Deviation, mean longitudinal.—The arithmetical mean of the longitudinal deviations of the points of impact of a series of shots.

100. Deviation, range.—The difference between the range to the target and the range to the point of impact.

101. Directing point.—A point at or near the battery for which relocation is made at the plotting room. It is the point over which the gun center of the plotting board is adjusted. When the pindle center of a gun is taken as the directing point, such gun is called the "directing gun."

102. Displacement of any point.—The horizontal distance in yards of that point from the directing point.

103. Drift.—The divergence of the projectile from the plane of departure due to the rotation of the projectile, its ballistic character, and the resistance of the air. It is generally in the direction of rotation, except for extreme elevations of high-angle fire, in which case it may be opposite to the original direction of rotation. For the United States service rifled guns it is to the right. It may be expressed either in yards or angular measure.

104. Elevation.—A general term to denote the inclination in a vertical plane given to the axis of the gun in pointing; the angle between the axis of the gun and the line of sight is the sight elevation; the angle between the axis of the gun and the horizontal is the quadrant elevation.

105. Elevation setter.—The member of a mortar detachment who lays the mortar in elevation.

106. Emplacement.—That part of the battery pertaining to the position, protection, and service of one gun, mortar, or group of mortars.

107. Emplacement book.—A book containing all necessary data concerning the battery.

108. Energy of the projectile.—The energy stored up in the projectile by the force of the expanding gases generated by the explosion of the powder charge. It is expressed usually in foot-tons. The formula for computing it is:

$$E = W V^2 / (4480 g),$$

in which W is the weight of the projectile in pounds, V its velocity in feet per second, and g the acceleration due to gravity (mean value 32.16).

109. Equalizing pipe.—A pipe connecting corresponding ends of two recoil cylinders for the purpose of equalizing the pressure therein.

110. Exterior crest.—The line of intersection of the superior and exterior slopes.

111. Exterior slope.—The outer slope of the battery.

112. Field of fire.—The area covered by the armament of a battery.

113. Fire area.—The area covered by the armament of a fire command.

114. Fire-control.—Fire-control is the exercise of those tactical functions which determine—

- (a) The objective of fire.
- (b) The volume and concentration of fire.
- (c) The accuracy of fire.

The term "fire-control system" includes the means employed in fire-control, the scheme of its installation, and the method of its use.

The material as installed, which is employed in the fire-control of a battery or district, is called the "fire-control installation" for that battery or district. Installations are either standard or provisional.

115. Fire-control material may be classified under the following heads:

- (a) Instruments for the observation and location of targets.
- (b) Instruments for the determination of firing data.
- (c) Communications.

The personnel employed in fire-control is called the "fire-control personnel."

116. The fire-control stations for the coast artillery service and the conventional signs and abbreviations therefor are as follows:

Station.	Abbrevia- tion.	Sign.
Battle commander's station	C	
Primary station of a fire command	F'	
Secondary station of a fire command	F''	
Supplementary station of a fire command	F'''	
Primary station of a battery	B'	
Secondary station of a battery	B''	
Supplementary station of a battery	B'''	
Emergency station of a battery	E	
Primary station of a mine command	M'	
Secondary station of a mine command	M''	
Supplementary station of a mine command	M'''	
Double primary station of a mine command	M'-M'	
Double secondary station of a mine command	M''-M''	
Separate observing room	O	
Separate plotting room	P	
Battery commander's station	B. C.	
Meteorological station	Met.	
Tide station	T	
Searchlight	S	 &c.
Post telephone switchboard	P. S. B.	
Signal station	SS	
Wireless station	WS	

117. Firing interval.—The interval of time between consecutive shots from the same gun or mortar in continuous firing.

118. Fixed light.—A searchlight used to keep the outer limit of the battle area illuminated.

119. Forcing cone.—The part of the bore immediately in front of the centering slope. It is formed by cutting away the lands so as to decrease their height uniformly from front to rear.

120. From battery.—The position of a gun when withdrawn from its firing position.

121. Gallery.—Any passageway covered overhead and at the sides.

122. Gas check.—The essential mechanical features of an obturator which enable it to prevent the escape of gas.

123. General defense plan.—Scheme of defense formulated prior to an attack. A variety of these plans, based on the character of attack to be expected, should be prepared and issued to the command.

124. Groove.—See Rifling.

125. Gun commander.—A noncommissioned officer who commands a gun section. The rated gun commanders authorized by law when assigned in command of mortar pits are called "pit commanders;" of ammunition sections, "chiefs of ammunition service."

126. Gun company.—A company assigned to the service of direct-fire guns only.

127. Gun differences.—Differences in range and azimuth to the target from the gun and from the directing point, due to gun displacement.

128. Gun displacement.—The displacement of the pintle center of the gun.

129. Gun platform.—That part of the battery upon which the gun carriage rests.

130. Gun pointer.—The member of a gun section who controls the aiming of a gun or laying it in azimuth (Case III), or the chief of a mortar detachment who supervises the loading and laying of a mortar.

131. Hoist room.—The room in the battery containing the receiving table of the ammunition hoist.

132. Hoop.—A cylindrical forging superposed upon the jacket or other hoops.

133. Identification of a target.—The act or process of recognizing a target which has been designated.

134. Illuminating light.—A searchlight whose primary function is to follow a target that has been assigned to a fire command.

135. In battery.—The position of a gun when ready for firing.

136. In commission.—The term to indicate those batteries to which personnel is assigned.

137. Indication of a target.—Any method employed to designate a target.

138. In service.—The term to indicate those batteries to which personnel is assigned and at which daily drills are held.

139. Interior crest.—The line of intersection of the interior slope with the superior slope. If there be no interior slope, it is the line of intersection of the interior wall and superior slope.

140. Interior slope.—The inner slope of a parapet connecting the interior wall and superior slope.

141. Interior wall.—The inner parapet wall.

142. Jacket.—A cylindrical forging, generally extending from the breech of a cannon to a plane beyond the trunnions.

143. Jump, angle of.—The angle between the line of departure and the axis of the bore when the piece is pointed. In determining the sight or quadrant elevation to be used, this angle must be applied as a correction to the angle of departure given in the range table; this correction differs for different guns, carriages, and ranges, and may be determined by experiment.

144. Lands.—See Rifling.

145. Land front.—Those portions of the defenses which are provided to repel an attack from the land area in rear of or on the flank of permanent seacoast works.

146. Laying.—Pointing the gun without the use of a sight. (See Pointing.)

147. Line of departure.—The direction of axis of the bore when the projectile leaves the muzzle.

148. Line of direction.—The line from the gun to the center of the target at the instant the shot strikes.

149. Line of impact.—The line tangent to the trajectory at the point of impact.

150. Line of shot.—The line from the gun to the point of impact.

151. Line of sight.—The straight line passing through the sights of the piece; at the instant of firing this line passes through the target.

152. Loading platform.—That surface upon which the cannoneers stand while loading the piece.

153. Loading position.—At gun batteries; breech closed, cannoneers at posts for inspection, projectile and powder charges on truck near delivery table.

At mortar batteries; mortars horizontal, breech closed, cannoneers, except No. 6, at posts for inspection, projectiles on trucks about 10 feet in rear of mortars, powder at entrance to pit. No. 6 is at the entrance to the powder magazine.

154. Loading tray.—A device used to protect the breech recess while loading.

155. Location of a target.—The determination of its range and azimuth from some given point.

Having the location of a target from one point, the process by which its range and azimuth from some other point are determined without further observation is called "relocation."

156. Machine guns.—Guns of one or more barrels using fixed ammunition and provided with mechanism for continu-

ous loading and firing. The mechanism may be operated by man power or by the force of recoil.

Guns in which the force of recoil is used to operate the breech block are termed "semi-automatic." When this force is used also to load and fire the guns, they are termed "automatic."

157. Magazines.—Rooms for the storage of powder, primers, fuses, etc.

158. Manning party.—The personnel assigned to the service of any specific element of the defense.

159. Manning table.—A list of the names of those who constitute a manning party, with the particular post to which each is assigned.

160. Meteorological message.—The message sent to fire commanders by a meteorological observer. It includes the barometer and thermometer readings, the atmosphere reference number, and the velocity and azimuth of the wind.

161. Mine (submarine).—A case containing a charge of explosive and appliances for firing it, to be fixed in position beneath the surface of the water.

162. Mine company.—Company assigned to the service of submarine mines.

163. Mine field.—Area of water in which submarine mines are planted.

164. Mortar company.—A company assigned to the service of mortars.

165. Muzzle.—The front end of a cannon.

166. Muzzle velocity.—The velocity of the projectile as it leaves the muzzle.

167. Observer.—A member of the fire-control section who is in charge of and uses an observing instrument.

168. Observing interval.—The time in seconds between two consecutive observations on a target.

169. Observing station.—A position constructed in a favorable place for observing the field of fire.

170. Obturator.—Any device for preventing the escape of gas. Obturation is the process of preventing the escape of gas.

171. Occult.—To shut off the beam of a searchlight.

172. Orders of fire.—

First. *Unrestricted fire.*—When the only limitation imposed by the fire commander upon the action of a battery is the assignment of a target the fire is said to be unrestricted. This is the normal fire action of a battery.

Second. *Restricted fire.*—When the range at which to fire, the number of shots, the firing interval, or any other limitation except as to target, is imposed upon the action of a battery, the fire is said to be restricted.

In unrestricted fire, and also in restricted fire when the rate is not specified, the fire should be as rapid as possible.

173. Orientation.—The process of adjusting an instrument, gun, or mortar in azimuth.

174. Orientation table.—A table showing the azimuths and distances of various points in the harbor.

175. Parados.—A structure in rear of a battery for protection against fire from the rear. It may have interior, superior, and exterior slopes.

176. Parade slope.—The rear slope or wall of an emplacement.

177. Parapet.—That part of a battery which gives protection to the armament and personnel from front fire.

178. Pit.—That part of a mortar emplacement designed for mounting one or more mortars, usually four.

179. Pit commander.—A noncommissioned officer (gun commander) in charge of a mortar pit.

180. Plane of departure.—The vertical plane containing the line of departure.

181. Plane of direction.—The vertical plane containing the line of direction.

182. Plane of sight.—The vertical plane containing the line of sight.

183. Plotter.—A member of the fire-control section in charge of the plotting.

184. Plotting board.—A board for the purpose of plotting the track of a ship and, in connection with range and deflection boards, determining the corrected data for firing. (See paragraphs 782 to 791, inclusive.)

185. Plotting room.—A room in which the plotting detachment works.

186. Pointing.—The operation of giving the direction and elevation necessary to hit the target. When the sight is used it is called "aiming;" when the sight is not used, it is called "laying."

There are three cases of pointing—

Case I. When direction and elevation are both given by the sight.

Case II. When direction is given by the sight, and elevation by the range scale on the carriage.

Case III. When direction is given by the azimuth scale and elevation by quadrant or by the range scale on the carriage.

187. Point of fall.—The point where the trajectory pierces the horizontal plane through the muzzle of the gun.

188. Point of impact.—The point where the shot strikes.

189. Position finder.—An instrument for locating a target.

The position finding system used in our service includes—

- (1) The horizontal base system, which employs azimuth reading instruments in stations at the ends of a base line, and a plotting board.
- (2) The D. P. F. system, which employs a depression position finder and a plotting board.
- (3) The emergency system, which ordinarily employs a self-contained instrument located at the battery, with or without a plotting board.

190. Powder chamber.—The portion of the bore for the reception of the powder charge. It is composed of the main chamber and a conical part (the centering slope), which unites the chamber with the forcing cone. The centering slope serves to bring the axis of the projectile to the axis of the bore.

191. Powder chute.—An inclined shaft for returning cartridges or dummies to the magazine.

192. Powder hoist.—A device for raising powder to the loading platform.

193. Powder hoist well.—The shaft through which the powder hoist operates.

194. Predicted point.—The point located on the plotting board at which it is estimated a target will arrive at the end of an assumed interval of time. This interval of time is called the "predicting interval."

195. Predicted time.—The time at which a target should reach the predicted point.

196. Predictor.—An accessory of the mortar plotting board used to locate the position of the predicted and set-forward points.

197. Primary station.—See base end station.

198. Primer.—A small tube containing materials which are ignited readily by friction, by percussion, or by an electric current. It is used to ignite the powder charge.

199. Priming charges.—Small charges of black powder in the ends of powder sections necessary for the ignition of smokeless powder.

200. Quadrant.—An instrument for giving quadrant elevation.

201. Quadrant elevation.—The angle between the horizontal and the axis of the bore when the piece is pointed.

202. Ramp.—An inclined plane serving as a means of communication from one level to another.

203. Range.—In a limited sense, the horizontal distance from the gun to the target. In a general sense it is applied to horizontal distances between position finder and target, position finder and splash, gun and splash, etc.

The range of a shot is the horizontal distance from the center of the gun to the point where the projectile first strikes.

204. Range-azimuth table.—A table of ranges and the corresponding azimuths from a gun to points in the center of the main ship channel or channels. It is kept at the gun and used for firing without the use of range-finding apparatus.

205. Range board.—A device for determining the range corrections which must be made for wind, atmosphere, tide, velocity, and travel of target during the observing interval and time of flight. (For nomenclature, adjustment, and use, see paragraphs 797 to 815, inclusive.)

206. Range difference.—The difference in range of a point from any other two points—as the difference between the ranges of a target from two guns of a battery.

207. Range finder.—An instrument for determining ranges.

208. Range keeper.—The member of the fire-control section who operates a time-range board.

209. Range officer.—The officer in immediate charge of all or a part of the fire-control section.

210. Range setter.—The member of the gun section who lays the gun for range.

211. Rapid-fire gun.—A single-barrel breech-loading gun provided with breech mechanism, mounting, and facilities for loading, aiming, and firing with great rapidity. The breech mechanism is operated by a single motion of the handle or lever. The smaller calibers use fixed ammunition.

212. Ready.—At gun batteries, a signal given to indicate to the gun pointer that the piece is ready to be fired. At mortar batteries, a signal given to the battery commander that the mortars are ready to be fired.

213. Rear slope.—The slope to the parade in rear of the battery.

214. Receiving table.—The hoist table on which ammunition is placed preparatory to raising.

215. Recoil.—The backward movement of the gun on firing. Counter recoil is the return of the gun in battery.

216. Recoil cylinder.—The hydraulic cylinder for controlling the recoil.

217. Reference number.—An arbitrary number used to avoid "plus" and "minus," "right" and "left" in data for firing.

218. Relay.—The command given when mortars are not to be fired as laid, but are to be fired on the next data furnished.

219. Reserve table.—A table in a sheltered position for reserve ammunition.

220. Restricted fire.—See orders of fire.

221. Rifling.—Helical grooves cut in the surface of the bore for the purpose of giving a rotary motion to the projectile. The rib of metal between two adjacent grooves is called a "land."

222. Rimbases.—The masses of metal uniting the trunnions with the trunnion band.

223. Round.—One shot from each piece of a battery.

224. Roving light.—A searchlight, the primary function of which is the detection of vessels in or approaching the battle area.

225. Salvo.—A round fired simultaneously from a mortar pit or battery, or from a gun battery.

226. Salvo point.—A selected point at which fire is to be concentrated.

227. Salvo table.—A table giving ranges and azimuths of salvo points.

228. Searchlight area.—The area of land or water illuminated by a searchlight.

229. Searchlight range.—The maximum distance at which a target can be illuminated sufficiently for range finding and identification purposes.

230. Secondary station.—See base end station.

231. Serving table.—A table for keeping a supply of projectiles convenient to the breech during loading. It is usually mounted on wheels.

232. Set-forward point.—A point on the course of a target in advance of the predicted point, located by laying off from the predicted point a distance equal to the travel of the target in the time of flight.

233. Shell room.—A room for the storage of projectiles.

234. Shell tracer.—An attachment to the projectile enabling its flight to be followed. Both day and night tracers may be used.

235. Shot gallery.—A gallery for the storage of projectiles.

236. Shot hoist.—A device for raising projectiles from the hoist room to the loading or truck platform.

237. Shot hoist well.—The shaft through which the projectile hoist operates.

238. Sight.—An instrument by which the gun pointer gives the gun the proper direction for firing. Sights are of two classes, open and telescopic; the former consists of two points which are brought into line with the target by the unaided eye; the latter uses the magnifying power of the telescope and is the standard sight. (See paragraph 821.)

239. Sight elevation.—The angle between the line of sight and the axis of the bore when the piece is pointed.

240. Striking angle.—The angle which the line of impact makes with the horizontal plane. It is equal to the angular depression of the point of impact plus the angle between the line of impact and the line of shot.

241. Striking velocity.—The velocity of the projectile at the point of impact.

242. Superior slope.—The top slope of a parapet or traverse.

243. Supplementary station.—See base end station.

244. Swell of the muzzle.—The enlargement of the exterior of the gun at the muzzle.

245. Tactical command.—Command at drill and during action.

246. Tactical responsibility.—Responsibility for all matters affecting the efficiency of a tactical command.

247. Targ.—The piece of metal used to indicate the intersection of the arms on the plotting board.

248. Target.—The object at which guns or mortars are pointed.

249. Telescopic sight.—See paragraph 821.

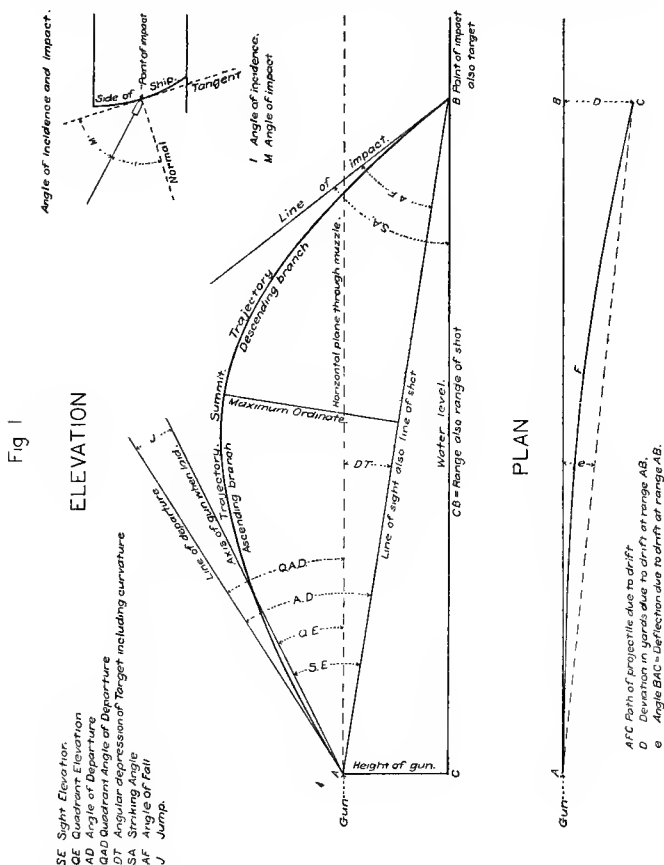
250. Throttling bar.—A bar in the recoil cylinder to regulate the size of the orifice through which the oil escapes from one side of the piston head to the other.

251. T-I bell.—A bell to indicate the observing interval.

252. Time-range board.—A board to show range at any instant. It is placed on the emplacement wall and operated on data from the plotting room.

253. Tracking.—The processes by which successive positions of a moving target are plotted on a chart. It includes the

observations by the observers at the position-finding instruments, plotting the results of these observations on the plotting board, and tracing thereon the plotted track of the target.



254. Trajectory.—The curve described by the center of gravity of the projectile in passing from the muzzle of the gun to the point of impact. (See fig. 1.)

255. Travel of projectile.—The distance from the base of the projectile in its seat to the muzzle of the gun.

256. Travel of target.—The distance passed over by the target in the time of flight. It is also used to express the distance passed over by the target in an observing interval.

257. Traverse.—The structure protecting the armament and personnel from flank fire.

258. Traversing indicator.—A device used by gun pointers to control the traversing of a gun without command.

259. Trial shots.—Shots fired before practice or action to determine—for guns, the muzzle velocity to be used; for mortars, the range and deflection corrections to be applied.

260. Trolley.—A mechanical device for transporting projectiles on horizontally suspended tracks.

261. Truck platform.—If the ammunition trucks run on a different surface from that of the loading platform, this surface is called the “truck platform.”

262. Truck recess.—The spaces in the parapet wall for the storage of ammunition trucks.

263. Trunnions.—The cylinders which rest in bearing surfaces of the carriage called “trunnion beds.” Their axis is perpendicular to the axis of the bore and ordinarily in the same plane; they connect the gun with the carriage and transmit the force of recoil from one to the other. The faces of the trunnions are the end planes perpendicular to their axis.

264. Trunnion band.—The hoop of which the trunnions form a part.

265. Tube.—The inner portion of a built-up gun extending usually from the breech to the muzzle.

266. Twist of rifling.—The inclination of the grooves to the axis of the gun at any point. When this inclination is constant the twist is uniform; when it increases from the breech to the muzzle it is increasing. Twist is generally expressed in turns per caliber, e. g., one turn in 40 calibers, meaning that the projectile makes one complete revolution in passing over a length of bore equal to 40 calibers.

267. Unrestricted fire.—See Orders of fire.

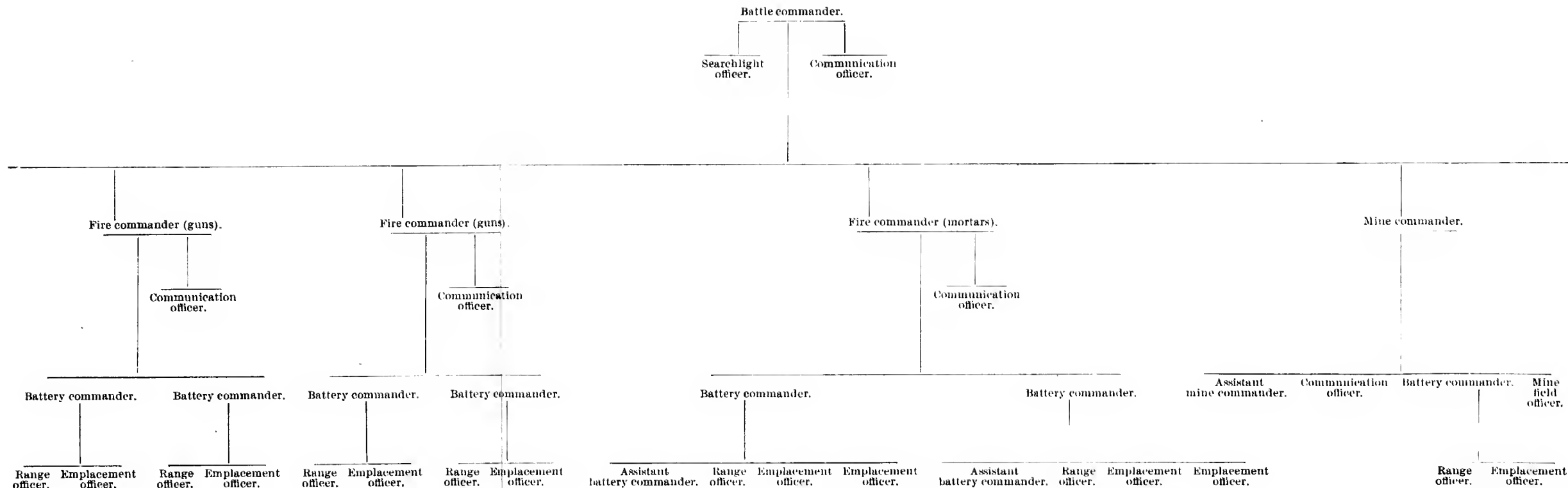
268. Vent.—A small channel leading from the exterior to the powder chamber for ignition of the powder charge.

269. Water front.—That portion of the defenses bearing upon the navigable water areas that may be open to an enemy.

270. Wind component indicator.—A device for determining the reference numbers corresponding to the transverse and longitudinal components of the wind. (See paragraphs 824 to 828, inclusive.)

271. Zone.—In mortar firing, the area in which projectiles fall for a given charge of powder, when the elevation is varied between the minimum and maximum.

It is also used with reference to other portions of the defensive area, as “outer defense zone,” “inner defense zone,” etc.



CHAPTER III.

ORGANIZATION.

272. The coast artillery tactical commands require manning parties for—

- Battle commanders' stations.
- Fire and mine commanders' stations.
- Battery commanders' stations.
- Observing stations.
- Plotting rooms.
- Mining casemates.
- Loading rooms.
- Mine planters.
- Searchlight stations.
- Power stations.
- Signal stations.
- Meteorological stations.
- Tide stations.
- Emplacements.

These parties are furnished by the coast artillery personnel (officers, noncommissioned staff officers, and enlisted members of the companies).

273. The officers necessary for a typical battle command and their relations to each other are shown by the diagram.

274. The assignment of field officers as battle commanders, fire commanders, and mine commanders, and of staff officers or other officers as searchlight officers and communication officers is made by the district commander.

275. Officers other than staff officers shall not be detailed as communication officers if such details will reduce the number of officers present with a battery to less than that required by its manning table. If no officer is available, a suitable non-commissioned officer may be designated to act as communication officer.

276. In case no field officer is available for assignment as fire or mine commander the senior officer of the organizations assigned to that fire or mine command acts as fire or mine commander.

277. The senior officer of the organization or organizations assigned to a battery is the battery commander.

278. The district commander assigns companies to particular batteries in accordance with the assignment to calibers by the War Department.

279. Mine commanders assign the officers of the companies of the mine command in accordance with their special fitness.

280. Battery commanders assign the officers of their batteries in accordance with their special fitness.

281. In the case of target practice or other work by battery required to be under the supervision of a fire or mine commander, some officer other than the battery commander, preferably the post commander or other field officer, should perform the function of fire or mine commander in the particular case.

282. When two or more companies are assigned to one battery, officers not designated as range or emplacement officers, or detailed for duty in battle or fire commanders' stations, may be put in charge of emergency stations, ammunition service, or distant observing stations, as may be considered most advantageous by the battery commander.

In general, the officer next junior to the battery commander should be assigned to a station or duty which will permit of his succeeding to command without delay or confusion. When the plotting room is adjacent to the B. C. station, the battery commander may assign both lieutenants as emplacement officers.

283. The enlisted personnel of companies is divided into sections, detachments, and details, as follows:

A gun company into—

Fire-control section, gun sections, ammunition section, and reserve section.

Fire-control section into observing detachment and plotting detachment. Observing detachment into details for the various observing stations; and plotting detachment into plotting board detail, computing detail, and communication detail.

Gun section into gun details for the service of the piece.

Ammunition section into projectile and powder details.

A mortar company into—

Fire-control section, pit sections, ammunition sections, and reserve section.

Fire-control section into observing detachment and plotting detachment. Observing detachment into details for the various observing stations; plotting detachment into plotting board detail, computing detail, and communication detail.

Pit section into mortar detachments (normally four). Mortar detachment into various details for service of the piece.

Ammunition section into projectile and powder details.

A mine company into—

Fire-control and power section, planting and loading section, gun sections, ammunition section, and reserve section.

A mine company into—Continued.

Fire-control and power section into observing detachment, plotting detachment, and power detachment. Observing detachment into details for the various observing stations; plotting detachment into plotting board detail and communication detail; power detachment into casemate detail and searchlight detail. Planting and loading section into planting detachments and loading detachments. Planting detachments into planter details and small boat details. Loading detachment into loading-room detail, explosive detail, and cable detail.

Gun sections into gun details for the service of the pieces. Ammunition section into projectile and powder details.

284. Certain men may be assigned to planting and loading sections and also to gun sections, as, in general, the service of the latter will not take place simultaneously with that of the former.

285. The senior noncommissioned officer of each section, detachment, and detail is its chief. Each chief commands his own subdivision whenever it acts separately and is responsible for its drill, its efficiency, and the condition of the material to which it is assigned.

286. A permanent manning table of the forces for the armament and its accessories shall be made out as follows and always kept up to date:

In each artillery district—

- (a) For the signal stations.
- (b) For the district boats.

In each post—

- (a) For the meteorological station.
- (b) For the tide station.

In each battle command—

- (a) For the battle commander's station.
- (b) For the searchlights of the battle command.

In each fire command—

- (a) For the fire commander's station.
- (b) For the power stations.
- (c) For the illuminating lights of the fire command.

In each mine command—

- (a) For the fire-control stations.
- (b) For the power, casemate, and searchlight stations.

In each company assigned to a gun battery—

- (a) For the fire-control stations.
- (b) For each gun.
- (c) For the ammunition section.
- (d) For the reserve section.

In each company assigned to a mortar battery—

- (a) For the fire-control stations.
- (b) For each pit.
- (c) For each ammunition section.
- (d) For the reserve section.

In each company assigned to the mine defense—

- (a) For the fire-control and power stations.
- (b) For the planting and loading section.
- (c) For the rapid-fire guns.
- (d) For the reserve section.

287. On request of battle and fire commanders the enlisted members of manning parties for battle and fire commanders' stations are detailed from post headquarters.

288. In obedience to instructions from the mine commander, the enlisted members of the manning parties for mine command stations are assigned by commanders of the companies assigned to the mine defense.

289. Company commanders must keep two men trained for each position for which they furnish details in the manning party of the battle and fire commanders' stations and two men for each position in the fire-control section of the battery.

290. Commanders of mine companies must keep two men trained for each position for which they furnish details in the fire-control and power sections.

291. Members of companies assigned to manning parties for battle, fire, and mine commanders' stations are carried on company manning tables in the sections to which their duties pertain.

292. Rated enlisted men of a mine command or a battery are appointed from duly qualified candidates by the district commander upon recommendation of company commanders approved by the mine or battery commander.

293. Rated enlisted men for battle or fire command stations are appointed from duly qualified candidates by the district commander on recommendation of the battle or fire commander.

CHAPTER IV.

MARCHING MANEUVERS.

TO FORM THE COMPANY.

294. For artillery drill.—The company commander or officer designated by him supervises the formation and the other officers proceed directly to their stations.

295. The company is formed by sections in two ranks facing to the front; the sections are arranged from right to left in the order named in paragraph 283. At the sound of the assembly the first sergeant takes post about 6 paces in front of the position at which the center of the company is to rest, faces it, and commands **FALL IN**. At the command **FALL IN** the chiefs of section take post facing the company, 3 paces from and opposite the center of the space to be occupied by their sections, and supervise the formation.

296. The sections fall in in two ranks with intervals of 2 paces between sections and 4 inches between files in each section. The distance between ranks is 40 inches; the distance from the rear rank to the line of file closers is 2 paces. Detachments and details form from right to left in the order named in paragraph 283 and in the drill for each piece. Each chief of detachment or detail, if the section is not divided into detachments, indicates the position for the right of his detachment or detail and falls in on the right of the first front rank file of the detachment or detail; the unnumbered members fall in on his left in the front and rear ranks and the numbered members on their left, odd numbers in the rear rank. Mechanics and musicians take post in the line of file closers behind the sections to which they are assigned in the manning table, at the command **FALL IN**. When practicable, mechanics may be sent to the emplacements before the company is formed.

297. When the company has formed the first sergeant commands **CALL ROLLS**. The chiefs of section call the rolls and face about. The first sergeant then commands **REPORT**. Each chief of section salutes, reports "——— section present" (or names of unauthorized absentees) and takes his place in the line of file closers opposite the center of his section and 2 paces in rear of it. The first sergeant does not return the salutes of the chiefs of section.

298. After receiving the reports of the chiefs of section the first sergeant faces about, salutes, and reports to the company commander, who will have taken his place 12 paces in front of the center of the company while it is forming. The com-

pany commander salutes and directs the first sergeant to take his post or to replace unauthorized absentees by members from the reserve section. After replacing the absentees the first sergeant takes his post in the line of file closers, 2 paces in rear of the second file from the right of the right section, and the company commander directs any subdivisions whose stations are at a distance from that of the main part of the company to proceed directly to their stations under the command of their chiefs. Then he marches the remainder of the company to its station (gun battery, mortar battery, or mine-work station). The chief of the right detachment is the right guide; when moving by the left flank the noncommissioned officer in the file closers nearest to the flank acts as guide, taking post in front of the front-rank men of the left file of the left section as soon as the company is faced to the left. If the formation is under arms, the files fall in with the pieces at "Order." The chiefs of section salute and report with their pieces at "Order" and move to their posts with their pieces at "Trail," coming to "Order" upon halting.

299. The first sergeant takes his place and receives the reports with his piece at "Order;" he then comes to "Right shoulder," commands **PORT ARMS, OPEN CHAMBER, CLOSE CHAMBER, ORDER ARMS**, faces about, salutes, and reports to the company commander. The company commander salutes and gives the first sergeant instructions or directs him to take his post. The first sergeant proceeds to his post at "Right shoulder," and on halting comes to "Order."

The company commander draws saber after his instructions to the first sergeant.

300. Officers do not wear their side arms to formation unless enlisted men form under arms.

301. For roll calls.—The formation is as prescribed in paragraphs 295 to 298, inclusive, except that the company commander takes post facing the front 3 paces in front of the center of the company after the report of the first sergeant, who takes post in the line of file closers in rear of the second file of the right section. If no officer is present at the roll call, the first sergeant takes post 2 paces to the right of the right section. Any officers present at the formation in addition to the company commander take post, as soon as the first sergeant reports, in rear of the sections to which assigned in the manning table and on the right of the chiefs of section.

302. Prior to each roll call the first sergeant posts the names of authorized absentees, and for drill the names of the substitutes from the reserve section; the substitutes fall in with the sections to which assigned temporarily. The chiefs of section prepare their rolls in conformity with the information posted.

303. For infantry maneuvers.—The formation is as prescribed in paragraph 295, except that the company commander directs the first sergeant, when the latter reports, to form as infantry, whereupon the first sergeant faces about and com-

mands **AS INFANTRY, FORM**. At the second command the company forms as prescribed in Infantry Drill Regulations, except that squad leaders do not report and that sergeants and corporals may be placed as Nos. 1 and 4 of the front rank when the reduced strength of the company makes it advisable. As soon as the company is formed properly the first sergeant faces about, salutes, and reports to the company commander, "Sir, the company is formed." The company commander returns the salute and the first sergeant takes post. The company commander draws saber, if under arms, and takes his post facing to the front 3 paces in front of the center of the company.

304. For all marching maneuvers other than marching to the battery, Infantry Drill Regulations shall be followed.

TO MARCH TO THE BATTERY.

305. The officer in charge of the formation marches the company by the flank and takes his post by the leading guide. Unless the distance to be marched is short he commands **TAKE DISTANCE, MARCH**. The leading file continues the march, the others mark time, and each resumes the full step when it has a distance of 40 inches.

306. To close to facing distance, the command is **CLOSE, MARCH**. At this command the leading file marks time, the others close successively to facing distance, and resume the march, or halt, at the commands **FULL STEP, MARCH**, or **COMPANY, HALT**. The commands for taking distance and closing when the company is at a halt are the same as above and executed in the same way.

TO POST THE SECTIONS.

307. When arriving near the battery or mine work station the officer in charge commands **SECTIONS, POSTS**, falls out, supervises the posting of the sections, and takes his station. Each chief of section marches his section to a point near its station, halts it, and commands **DETAILS, POSTS**. The members of the detachments and details fall out, obtain any implements and equipments which must be taken from the store-room, and take their posts.

308. Each chief of section determines whether or not all apparatus and material to be served by his section is in order, and reports to the officer directly over him, "Sir, ——— in order," or reports any defects he is unable to remedy without delay. As soon as the chiefs of section have reported, the officers report to the battery commander, who then reports to the fire commander's station, "Battery ——— in order," or reports defects he is unable to remedy without delay.

309. After all batteries of a fire command have reported the fire commander reports to the battle commander.

310. Members of the manning parties for fire and battle-command stations report individually at their stations. After the range officers of the mine command have reported to the mine commander the latter reports to the battle commander.

311. A battle command or a smaller command may be manned by sounding call to arms. In this case each member of the command proceeds as rapidly as possible directly to his post.

312. To dismiss the battle, fire, or mine command, the commander commands **CLOSE STATION**. His station, if manned, is closed. The order is transmitted to the lower units. The battery commanders command **BATTERY DISMISSED**; range officers command **CLOSE STATION**; emplacement officers command **DISMISSED**; officers see that everything for which they are responsible is in order. All stations are closed, equipments replaced, the company formed under supervision of an officer, and marched by him to the company parade and dismissed.

313. Subdivisions from remote stations are marched to the company parade and dismissed by their chiefs.

CHAPTER V.

THE BATTERY—GENERAL DUTIES.

314. The battery commander keeps a record of the daily attendance at artillery drill and instruction, with names of absentees, reasons, and authority for such absence.

315. The battery commander is responsible—

First. That the personnel of his battery is efficient in drill, in practice, and in action.

Second. That the equipment and fire-control installation provided for his battery are in serviceable condition and that no permanent modifications are made therein without proper authority.

Third. That the officers and men of his battery are instructed in the care, preservation, and use of artillery material as prescribed in these regulations and in orders.

Fourth. That the records are kept as prescribed in these regulations and in orders.

Fifth. That the prescribed reports are rendered.

The battery commander shall make every effort to keep his battery supplied with the proper equipment, implements, and reserve ammunition.

316. The battery commander is authorized to modify the manual of the piece as prescribed in these regulations to such extent as may seem to him advantageous, provided that the officers and men are first well instructed in the prescribed drill, and provided that the precautions for safety, paragraphs 647 to 658, inclusive, paragraphs 684, 685, and 687, and paragraphs 693 to 695, inclusive, shall be strictly adhered to at all times. He is authorized to make temporary modifications or changes in the fire-control installation as may seem to him advantageous, provided that such modifications or changes do not prohibit the prompt return of the installation to its original condition. Permanent changes in the provisional installations may be made upon the approval of the district commander, who shall report such changes to the War Department. Permanent changes in the standard installation shall be made only upon authority of the War Department. The battery commander is encouraged to improvise devices and methods which in his opinion will simplify the fire-control system or increase the efficiency of his command, and with the approval of the district commander is authorized to test such devices or methods at target practice. When the result is favorable to the device or method, the test shall be made the

subject of a detailed report, accompanied by drawings and models of any device used. The assistance of the proper staff officers of the post or district should, upon application, be given to battery commanders for the purpose of making temporary changes in fire-control installations or in constructing simple devices in accordance with their ideas, provided that no unauthorized expenditure of funds be involved. This paragraph shall not be taken as authority for increasing the load upon any fortification plant without authority of the War Department.

317. The period of indoor instruction is utilized for the instruction of gunner candidates, but this should not be permitted to interfere with keeping plotting-room details and telephone operators in practice. The duty of keeping the members of plotting-room details for fire and battle commanders' stations in practice during the period of indoor instruction devolves upon battery commanders.

318. Battery commanders make a complete inspection of their batteries weekly, weather permitting. This inspection includes a test of the fire-control system, using a moving target for vessel tracking when practicable.

319. In battle command or fire command drill or action the battery commander's exercise of fire-control is limited by orders which come to him from higher commanders. When **BATTERY COMMANDER'S ACTION** is ordered he exercises independent fire-control and fights his battery in accordance with his own judgment.

320. In case of emergency battery commanders act without waiting for orders.

321. The battery commander goes wherever his presence is necessary, but upon quitting his station he leaves instructions as to where he may be found.

322. Prior to drill, practice, or action the battery commander receives the reports of the emplacement officers and the range officer and reports to the fire commander, "Battery ——— in order," or reports defects he is unable to remedy without delay.

323. In case of breakdown of the lines of communication from either of the base-end stations the battery commander gives orders for the use of the other as a secondary with the B. C. station as a primary, his observer operating the B. C. instrument; in case of the loss of communication with both stations he gives orders for the emergency system to be used, transferring his station to the emergency station if necessary.

324. The emplacement officer is in charge of one or more emplacements. He is responsible to the battery commander for the condition of the emplacement material and for the efficiency of its service.

Before drill, practice, or action he makes a careful inspection of the material under his charge.

Having completed the inspection and having received the reports of the chiefs of section, he reports to the battery commander, "Sir, No. ——— (or Pit ———) in order," or reports defects he is unable to remedy without delay.

At the conclusion of the exercises for the day he commands **DISMISSED**, inspects the emplacement, and reports to the battery commander.

325. The range officer is in charge of the fire-control service of the battery and his station is at the battery plotting room. He is responsible to the battery commander for the condition of the fire-control material and for the efficiency of its service.

Before drill, practice, or action he makes a careful inspection of the equipment of his station, verifying the adjustments of the plotting board and of other apparatus.

Having completed the inspection and having received the reports of the chiefs of detail, he reports to the battery commander, "Sir, fire-control stations in order," or reports defects he is unable to remedy without delay.

At the conclusion of the exercises for the day he directs that the stations be closed, inspects his station, and reports to the battery commander, handing him all records pertaining to the day's work at his station.

326. Observers are selected on account of their special aptitude, and must understand thoroughly the use of their instruments and have a knowledge of the general features of war ships in order to be qualified for their duties. Each observer is responsible for the care and adjustment of his instrument and for the security and police of his station at all times, and reports to the range officer deficiencies, defects, or accidental damages as soon as they are known. With the type installation, 1909, each observer at the base end stations wears a head receiver and breast transmitter bridged on a line (observer's line) to the B. C. station, for the purpose of communicating with this station while he is observing.

327. In order to select observers who are to work at the ends of the same horizontal base line, two instruments should be set up as near together as practicable and oriented carefully. The observers, using these instruments, track a moving target. Every fifteen seconds a bell is struck three times or **READY, TAKE** called, and the readings of the two instruments compared.

328. The maximum distance within 12,000 yards at which the depression position finder may be expected to give sufficiently accurate ranges under favorable conditions is a distance equal to 800 yards for every 10 feet of height of the instrument above the water. Up to this distance the average error of the instrument should be within three-fourths of 1 per cent of the range.

329. Arrangements should be made so that observers may compare frequently the ranges to moving objects as determined by a horizontal base, with the readings of the D. P. F. This comparison should be made during the progress of the observations by calling aloud both results. If the plotting board is not at the primary station, the H. B. range can be sent there by telephone.

330. At least once a month during the outdoor season D. P. F. observers shall be tested as to their proficiency at

ranges within the maximum for height of instrument as above described. The test should be conducted so as to determine the relative ability of various observers to read quickly and accurately ranges to fixed and moving objects.

331. Each reader reads and transmits the azimuth or azimuth and range to the plotting room.

332. The plotter is responsible for the adjustment and operation of the plotting board.

333. Each member of the fire-control section on reaching his station examines the instrument or other material to which he is assigned, makes the prescribed tests and adjustments, and reports defects, if any, to his chief of detail.

334. Each gun of a gun battery is commanded by a gun commander and each pit of a mortar battery by a pit commander, who are responsible to the emplacement officers for the condition of the material and the efficiency of the personnel of their commands. They supervise the gun cleaning and require the mechanics to keep pieces and carriages painted and to fill the grease cups at least once each week. They supervise the service of the guns and mortars and take station at the most convenient places for this purpose.

335. A gun pointer is assigned to each gun and mortar in commission and is responsible for the condition and adjustment of the sight and sight standard or the quadrant. At mortar batteries he is also responsible for the condition of the piece, and superintends the drill of the detachment.

336. One mechanic, or acting mechanic, is assigned, under the gun commander, to each 8-inch, 10-inch, and 12-inch gun emplacement, to each mortar emplacement, and to each battery of the smaller armament in commission. He is in immediate charge of all small stores and supplies at the emplacement or battery to which assigned.

CHAPTER VI.

SERVICE AT THE EMBLACEMENTS.

GENERAL INSTRUCTIONS.

337. The service of the piece should proceed with as few orders as possible, and aside from the necessary orders and instructions no talking of any kind should be permitted.

338. The instructor should place himself where he can be seen and heard by all. His explanations should be given with life, in a distinct voice, the tone of which should not be monotonous. He should train the gun commanders and gun pointers in giving commands, which should be quick and clear, but not louder than necessary.

339. The instructor should avoid uncommon expressions, long explanations, and details of manufacture. He should require each man to take the position he is to occupy at any stage of the drill, and when necessary illustrate in detail how every operation should be performed.

340. Endeavor should be made to interest the men in their work and to train them on such a system that they will learn their duties thoroughly, with as little weariness to themselves and as quickly as possible. It is desirable to get them, from the beginning, to drill with precision and without unnecessary noise.

341. As soon as possible actual loading with dummy ammunition and pointing the gun as for service are practiced.

342. It is not necessary to proceed in the exact order in which the drill is written. The instructor should use discretion in adopting a system by which the details of the drill can be taught readily.

343. All changes of position of cannoneers in serving the piece are executed at a run.

344. At the command **TAKE COVER**, given at any time, all numbers not designated to remain at their posts move at a run to some designated place under cover. As a rule this command is given in mortar batteries only.

345. At the command **STAND FAST**, the cannoneers halt until the previous command is repeated.

When one number makes a mistake the command **STAND FAST** should be given and the error pointed out.

346. A drill primer or a fired standard primer is used always at drill.

347. Primers are inserted while the breech is fully open.

348. Service primers are adjusted in manufacture to require a pull of about 25 pounds to start the wire to the rear, and about 40 to 45 pounds to pull the teeth through the compressed friction pellet and explode it.

349. The lanyard should be pulled from a position as near the rear of the gun as possible, since pulling it from the side will cause a variable part of the pull to be absorbed by friction in the firing leaf. A strong, quick pull—not a jerk—from one man, with as short a lanyard as practicable, should be used. When a long lanyard is used, the slack causes the force to be applied to the primer slowly, and this increases the chances for a misfire. The quicker the pull the better for firing the primer, but when a man attempts to pull by a jerk he uses his arms only, losing the assistance of his body, and the strength of his pull is less. If a primer can not be discharged by one man, it should be rejected and another used.

350. Obturating primers are constructed so that when a primer is pulled and fails to fire, the primer wire is free to move forward without causing the composition to ignite. As an extra precaution, however, to prevent any attempt to use again a primer that has failed, the primer wire, immediately after ejection, should be bent around the primer through an angle of about 180° .

351. With guns where the mechanism permits, the lanyard may remain hooked to the firing leaf during drill, practice, or action.

352. Constant inspection of the safety pin on the firing leaf of the breech mechanisms in which combination primers are used should be made, since if the safety pin should be broken by harsh treatment and the pull upon the lanyard be upward by about 10° the primer probably would be ejected at the instant of firing and might injure the cannoner firing the piece.

353. Signals.—The commands or signals, **ELEVATE**, **DEPRESS**, **RIGHT**, or **LEFT**, given in pointing, always refer to the direction of motion of the muzzle.

ELEVATE.—Raise either hand to the height of the head, fingers pointing upward.

DEPRESS.—Raise either hand to the height of the head, fingers pointing downward.

RIGHT or **LEFT.**—Motion with either hand, fingers pointing in the desired direction.

CLAMP or **HALT.**—Raise either hand to a horizontal position, fingers closed.

READY.—Raise either arm vertically to its full extent, fingers extended.

Signals with whistles or bugles are authorized also.

354. The battery commander takes his place at the B. C. station, receives the reports of the fire-control and emplacement sections and conducts battery drill.

355. To load and fire.—The battery commander indicates the target, designates the kind of projectile to be used, and commands or signals:

- (a) No. ———, Fire ——— shots, Commence firing; or
- (b) Fire ——— rounds (or salvos), Commence firing; or
- (c) Commence firing.

Commands (a), (b), or (c) may be preceded by the command **NO.** (or **BATTERY**) ———, **LOAD**, when the piece is to be loaded but not fired, in which case disappearing guns are held from battery until the command **COMMENCE FIRING**.

The command **FIRE** ——— **ROUNDS** (or **SALVOS**), **COMMENCE FIRING**, or **NO.** ———, **FIRE** ——— **SHOTS**, **COMMENCE FIRING**, signifies that ——— rounds (or salvos) or shots are to be fired; after firing the prescribed number of rounds (or salvos) or shots the details take posts (bringing the piece to the loading position at mortar batteries), open the breechblock, and clean the block and breech recess.

The command (c), **COMMENCE FIRING**, signifies that the firing is to be taken up at once and is to be continuous; when a salvo or shot has been fired, the details load and fire without further command until the command **CEASE FIRING**.

356. At the conclusion of drill, practice, or action, the battery commander commands **BATTERY DISMISSED**.

MORTAR BATTERY.

357. Each emplacement is in charge of an emplacement officer and is manned by a pit section (53 enlisted men), consisting of a pit commander (a noncommissioned officer) and four mortar detachments; and an ammunition section (approximately 31 enlisted men), consisting of a chief of ammunition service (a noncommissioned officer), and such noncommissioned officers and privates as the location of the galleries and magazines and facilities for serving ammunition require. Each mortar detachment consists of a gun pointer, an azimuth setter (a noncommissioned officer or private), an elevation setter (a noncommissioned officer or private), and 10 privates.

358. The emplacement officer receives the reports of the pit commander and the chief of ammunition service, tests the electrical firing circuit, and reports to the battery commander, "Sir, pit A (or B) in order," or reports defects he is not able to remedy without delay.

He sees that the orders of the battery commander are executed, repeating them when necessary. He provides himself with a stop watch, observes the progress of the loading, and if it is apparent that either one or two pieces will not be laid in time he commands **NO.** ——— or **NOS.** ——— **AND** ——— **TAKE COVER.** If it is apparent that more than two pieces will not be laid in time, he commands **RELAY** and reports to the battery commander. When two or more pieces are laid and all detachments have taken cover, he closes the safety switch and reports or signals **A** (or **B**) **PIT READY** to the battery commander.

Should circumstances arise after he has reported or signalled **PIT READY** to the battery commander that in his opinion would make it unsafe to fire, he breaks the firing circuit (or causes lanyards to be quitted when firing by lanyard) and reports to the battery commander.

359. The pit commander is in charge of the pit, and in the absence of the emplacement officer is in charge of the entire emplacement, in which case he performs the duties prescribed for the emplacement officer.

On the arrival of the section at the emplacement he commands **DETACHMENTS POSTS**, and supervises the procuring of implements and equipments. When detachments have taken posts he commands **EXAMINE GUN**, makes a general inspection of the pit, accompanied by a mechanic with an oiler. He receives the report of the gun pointers and reports, "Sir, pit in order," or reports to the emplacement officer defects he is not able to remedy without delay. He superintends the removal of the old primer and the inserting of a new one or the opening of the breech after a misfire, as prescribed in paragraphs 650 and 651.

At the command **DISMISSED** of the emplacement officer he commands **SECURE PIECES, FORM SECTION**. He supervises the replacing of equipments and implements, sees that the pieces are secured, and then forms his section on the battery parade.

360. The gun pointer commands the mortar detachment and is directly responsible for the condition of the piece and the drill of the detachment. At the command **DETACHMENTS POSTS** he marches the detachment to the piece and commands **POSTS**. He supervises the procuring of implements and equipments. At the command **EXAMINE GUN** he makes a careful inspection of the piece and reports to the pit commander, "No ——— in order," or reports defects he is unable to remedy without delay. He supervises the service of the piece, taking position on the end of the rammer when the projectile is being launched. He gives the command **ELEVATE** as soon as the rotation of the block has begun, and when the piece is laid for elevation commands **CLAMP**. He verifies the laying of the piece both in azimuth and elevation, and is the last of his detachment to take cover. If his detachment is directed to take cover before the piece is laid, he cuts it out of the firing circuit by opening the proper switch. He causes No. 2 to quit the lanyard when firing by lanyard.

He observes the muzzle of his mortar when a salvo is fired, and in case of a misfire calls out, "No. ——— misfire."

361.

12-inch mortar (carriage model 1896).

Details.	At command POSTS.	At command EXAMINE GUN.
Azimuth setter (noncommissioned officer or private).	The azimuth setter takes post at the traversing cranks, facing the mortar.	The azimuth setter examines the azimuth index for adjustment by observing the mark made on the racer when the piece was last oriented, and examines and tests the traversing mechanism.
Elevation setter (noncommissioned officer or private).	The elevation setter takes post at the quadrant, facing it.	The elevation setter examines the quadrant and tests the elevating mechanism, assisted by No. 6.
Breech detail, Nos. 1, 2, and 3; No. 1 is chief of detail.	No. 1 procures a wiper or cotton waste and a can containing synovial oil and a sponge. He places the can convenient to the breech, and takes post one yard to the rear and right of the breech facing it. No. 2 procures a wiper or cotton waste and the long lanyard which he coils with the hook on top and places convenient to the breech. He takes post one yard to the rear and left of the breech, facing it. No. 3 procures the primer pouch and the holder containing punch and drill. He procures the bore and chamber sponge and places it on the rack or prop and takes post to the right of the breech, facing No. 1.	Nos. 1 and 2 remove the breech cover and place it at the designated place. No. 1 examines the breech mechanism, breechblock, breech recess, chamber, and bore. If the chamber or bore needs sponging he calls for the sponge and sponges, assisted by Nos. 2, 3, and 4. No. 2 examines the breech recess and gas-check seat, cleans and oils them, examines the long lanyard, and assists in sponging. No. 3 examines the safety lanyard device, firing attachment, vent, and short lanyard. He clears the vent and cleans primer seat. He assists in sponging.

361.

12-inch mortar (carriage model 1896).

At command LOAD or COM-MENCE FIRING .	At command RELAY .	At command UNLOAD .
The azimuth setter takes post at a run and traverses the piece rapidly to the nearest limit of the loading position as indicated by a paint mark on the iron portion of the azimuth circle. He then traverses the piece as rapidly as possible to the azimuth setting posted.	The azimuth setter returns to the piece at a run, unclamps and sets the piece for the new azimuth, and takes cover.	The azimuth setter unclamps and traverses the piece to the nearest limit of the loading position.
The elevation setter takes post at a run, unclamps and depresses the piece to the loading position as rapidly as possible, but without shock, and clamps it. He sets the quadrant for the elevation as soon as it is posted, and assisted by No. 5 elevates rapidly to the approximate elevation. Then he sets the piece accurately, commands CLAMP, and takes cover. Nos. 1, 2, and 3 take posts at a run.	The elevation setter returns to the piece at a run and lays the piece for the new elevation, commands CLAMP, and takes cover.	The elevation setter returns to the piece and proceeds as at the command COM MENCE FIRING until the piece is clamped in the loading position.
Nos. 1 and 2 open breech. No. 1 cleans and oils the breech-block, when necessary; assists in ramming, and in closing the breech. He commands ELEVATE as soon as he has started the rotation of the block, and takes cover as soon as the breech is closed. When necessary, he calls for the sponge and sponges chamber and bore, assisted by Nos. 2, 3, and 4. No. 2 wipes any residue from the gas-check seat and breech recess and assists in ramming. He pushes the powder charge into the chamber by hand until its base barely clears the gas-check seat, releases the tray latch, and assists in closing breech. When the mortar is to be fired by lanyard he attaches the long lanyard to the short one, straightens the lanyard after the detachment has taken cover, and pulls it at the command FIRE. He assists in sponging. No. 3 inserts a primer in the vent and lowers the leaf of the firing device <i>completely down</i>. When the mortar is to be fired by lanyard he hooks the short lanyard <i>after the piece is elevated above 45 degrees</i>, and takes cover. As soon as the breech is open, after the piece is fired, he removes the old primer, clears the vent and cleans the primer seat. He assists in sponging.	No. 1 remains at <i>cover post</i>. No. 2 slacks his lanyard. No. 3 remains at <i>cover post</i>. If the command DRAW POWDER CHARGE has been given also, Nos. 1 and 2 return to the piece at a run. No. 3 unhooks the short lanyard <i>before the mortar is depressed</i>, and as soon as the mortar is clamped in the loading position, Nos. 1 and 2 open breech. No. 2 withdraws the powder charge and passes it to No. 6 as soon as the latter has thrust in the new one. No. 2 pushes the new one in place and Nos. 1 and 2 close the breech. No. 3 hooks the short lanyard <i>after the piece is elevated above 45 degrees</i>. No. 2 straightens out the long lanyard and stands ready to fire.	Nos. 1 and 2 proceed as at the command RELAY, DRAW POWDER CHARGE, until the powder charge is withdrawn. Then they assist in withdrawing the projectile, and close breech. No. 3 returns to the piece, removes the primer as soon as the breech is opened, and assists in withdrawing the projectile.

361. 12-inch mortar (carriage model 1896)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Rammer detail, No. 4.	No. 4 procures the rammer and extractor, places the latter on the rack or prop, and takes post as prescribed for cover post, rammer vertical, head on the floor of the emplacement.	No. 4 places the rammer on the prop, brings up the sponge when called for, and assists in sponging.
Elevating detail, No. 5.	No. 5 procures a wrench for filling plugs, the measure containing hydrolene oil, and the funnel, and places them convenient to the piece. He takes post at the elevating handwheel clamp, facing it.	No. 5 unscrews the filling plugs of both recoil cylinders and, if oil is needed, fills them. Then he notifies the gun pointer that the cylinders are ready for inspection. After the inspection he screws the filling plugs well home and replaces his implements.
Charge detail, No. 6.	No. 6 takes post near the entrance of the powder magazine.	No. 6 removes the muzzle cover and places it at the designated place, assists the elevation setter in testing elevating mechanism, cleans and oils the gears.

361.

12-inch mortar (carriage model 1896)—Continued.

At command LOAD or COMMENCE FIRING .	At command RELAY .	At command UNLOAD .
No. 4 raises the rammer to a horizontal position, places the head against the base of the projectile, moves forward with the truck, and, assisted by the gun pointer, Nos. 1, 2, and 5, rams the projectile home with all possible force as the buffer of the truck brings up against the face of the breech. They withdraw the rammer quickly, the gun pointer, Nos. 1, 2, and 5 quit the rammer, and No. 4, carrying it above his head, takes post and brings it to a vertical position. When so directed, he places the rammer on the prop, brings up the bore and chamber sponge, and assists No. 1 in sponging. Then he replaces the sponge on the prop and takes the rammer to his post.	No duties.	No. 4 carries the rammer to the prop and brings the extractor to the breech, assists in withdrawing the projectile, returns the extractor to the prop, and takes the rammer to his post.
No. 5 assists in ramming, runs to the elevating handwheel, and at the command ELEVATE, elevates rapidly to the approximate elevation and clamps under the direction of the elevation setter, and takes cover.	No. 5 returns to the piece at a run, unclamps and clamps under direction of the elevation setter, and takes cover. If the command DRAW POWDER CHARGE has been given also, he proceeds as at the command COMMENCE FIRING, and takes cover as soon as the piece is again clamped in elevation.	No. 5 returns to the piece and proceeds as at the command COMMENCE FIRING until the piece is clamped in the loading position.
No. 6 receives the powder charge from a member of the powder detail of the ammunition section before leaving his cover post, and follows the truck to the breech. He holds the powder charge above his head and, as soon as the rammer is sufficiently withdrawn, thrusts it into the chamber, assisted by No. 2. Then he takes post at a run.	No. 6 remains at cover post except when the command DRAW POWDER CHARGE has been given also, in which case he brings up the next charge and thrusts it in the chamber as soon as No. 2 has withdrawn the old one. He then receives the old charge from No. 2 and takes cover, turning over the old powder charge to a member of the ammunition section.	No. 6 receives the powder charge from No. 2, returns it to the powder detail of the ammunition section.

361. 12-inch mortar (carriage model 1896)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Truck details, Nos. 7, 8, 9, and 10.	Nos. 7 and 8 bring out a loaded truck and run it to a point about 10 feet in rear of the breech, No. 7 on the right and No. 8 on the left. Nos. 9 and 10 run an empty truck alongside the delivery table in the shot gallery, No. 9 on the right and No. 10 on the left.	Nos. 7 and 8, 9 and 10, examine the trucks and clean and oil them.

361. 12-inch mortar (carriage model 1896)—Continued.

At command LOAD or COM- MENCE FIRING .	At command RELAY .	At command UNLOAD .
Nos. 7 and 8 (or 9 and 10) run a truck from the position of cover to the loading position (about ten feet in rear of the breech) and 9 and 10 (or 7 and 8) run a loaded truck from the gallery to the position of cover just vacated by 7 and 8 (or 9 and 10). At the proper time 7 and 8 (or 9 and 10) push the truck forward rapidly until it brings up against the face of the breech, timing their arrival at the breech so as to clear the block as it is swung to <i>open</i>. When the powder charge is pushed home they withdraw the truck promptly and run it backward into the shot gallery and alongside of the delivery table, roll a new projectile on the truck, and at the next shot run the reloaded truck rapidly to the position of cover just vacated by 9 and 10 (or 7 and 8), who have pushed their truck forward to the loading position.	No duties.	Nos. 7 and 8 (or 9 and 10) bring out empty truck from the gallery and when projectile is drawn back on to the truck return it to the gallery.

Notes on the drill.

362. The posts of the detachment for inspection are as given above.

363. At the command **TAKE COVER** the detachments take the positions indicated in the diagram.

364. The cover post for No. 4 is the same as his regular post, and the detachment forms on him at the command **TAKE COVER**. He does not quit the rammer except at the command **UNLOAD** or when directed to bring up the sponge or extractor, in which cases he places the rammer on the rack or prop. After replacing the sponge or extractor, he takes the rammer again and resumes his post.

365. When powder is not served from the rear of the pit, the cover post of No. 6 is near the entrance of the gallery from which powder is served.

366. In taking cover, the details proceed to their posts as rapidly as possible, but avoid interfering with those whose duties at the piece have not been completed.

367. Detachments at posts or cover posts stand at attention unless **REST** is ordered.

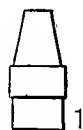
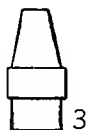
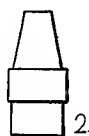
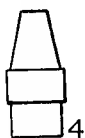
368. The service of the mortar is conducted habitually as though a salvo had just been fired (pieces elevated and detachments at cover post), but in case the command **COMMENCE FIRING** or **LOAD** is given when the detachments are at their posts and the pieces in the loading position, No. 6 proceeds at a run to the point designated for receipt of the powder charge.

369. **To open breech.**—The mortar should be clamped in a horizontal position. No. 1 releases the rotating crank by pulling on the wing nut and then turns the rotating crank contra-clockwise, as indicated by the "open" arrow, until the crank brings up short in a vertical position. No. 2 turns the translating crank briskly contra-clockwise until the shoulders of the grooves strike against the ends of the rails, when the block stops short and the shock frees the tray latch from its catch. If preferred, No. 1 may perform both operations. Nos. 1 and 2 then swing the tray and block to the right until the securing latch engages in the catch.

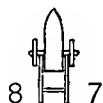
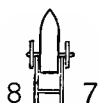
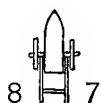
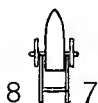
370. **To close breech.**—No. 2 releases the securing latch from its catch, and, assisted by No. 1, swings the tray and block to the left until the tray abuts against and is latched to the face of the breech. No. 2 then turns the translating crank clockwise until the breech block is translated completely. No. 1 turns the rotating crank clockwise as indicated by the "close" arrow until it brings up short and is secured by its catch.

371. With a fixed target, mortars are fired when ready. With a moving target, they are fired when the target reaches a predicted position. When mortars are equipped for firing by electricity, they are fired by the emplacement officer at the signal of the battery commander.

372. Mortars are fired by lanyard if the electrical firing circuit is not installed or is out of order. When the lanyard is



No. 4		No. 3		No. 2		No. 1	
E. S.	A. S.	E. S.	A. S.	E. S.	A. S.	E. S.	A. S.
2	1	2	1	2	1	2	1
4	3	4	3	4	3	4	3
6	5	6	5	6	5	6	5



E. S.=Elevation Setter
A. S.=Azimuth Setter

used, the emplacement officer commands **FIRE** at the firing signal of the battery commander.

Ammunition service.

373. The chief of ammunition service is in command of the ammunition section and in charge of the galleries and magazines for each emplacement.

He is responsible for the condition of the projectiles, trolleys, delivery tables, and for the police of the galleries and magazines.

On the arrival of his section at the emplacements he commands: **DETAILS, POSTS.**

When the details are posted he makes an inspection of the trolleys, magazines, and galleries and reports to the emplacement officer, "Sir, ammunition service in order." or reports defects he is unable to remedy without delay.

He is responsible that all trucks are loaded and delivery tables filled with projectiles at the beginning of an action. During drill or action he supervises the service of ammunition.

At the command **DISMISSED** of the emplacement officer he commands **SECURE MAGAZINES, FORM SECTIONS.** He sees that all his apparatus is in order, doors locked, and supervises the formation of his section.

374. The projectile detail transfers projectiles from the reserve supply to the delivery tables, and one man is stationed at each delivery table to assist the truck details in loading the empty trucks.

375. One or more men of the powder detail (depending on the location of the powder magazine) are assigned for the service of powder to each mortar. The charges are brought out as soon as the zone is announced and delivered to the Nos. 6 of the mortar detachments as soon as they are ready to receive them.

12-INCH GUN BATTERY, DISAPPEARING CARRIAGE.

376. The emplacements are in charge of an emplacement officer, or in case officers are available for such assignments each emplacement is in charge of an emplacement officer. Each gun is manned by a gun section (22 enlisted men), consisting of a gun commander (noncommissioned officer), a gun pointer (noncommissioned officer or private), a range setter (a noncommissioned officer or private), a chief of breech detail (a noncommissioned officer or private), and 18 privates. The ammunition section consists of a chief of ammunition service (noncommissioned officer) and details for each gun of the battery, each to consist of such noncommissioned officers and privates as the installation for the service of ammunition requires (for a two-gun battery, approximately 30 men).

377. The emplacement officer receives the report of the gun commander, and the chief of ammunition service tests the

electrical firing circuit, if installed, and reports to the battery commander, "Sir, No. ——— in order," or reports defects he is unable to remedy without delay. He sees that the orders of the battery commander are executed, repeating them when necessary. He observes the operation of loading and gives special attention to the record on the time-range board and to the laying of the piece for elevation.

378. The gun commander is in charge of the gun, and in the absence of the emplacement officer is in charge of the entire emplacement. On arrival of the section at the emplacement he gives the command **DETAILS POSTS**, and supervises the procuring of the implements and equipments by the various details. When the details have taken posts he commands **EXAMINE GUN**. He makes a general inspection of the gun and carriage, paying especial attention to the throttling valve, the recoil cylinders, and the oiling of the various bearings. In this inspection he is accompanied by the mechanic, with an oller. He reports to the emplacement officer, "Sir, No. ——— in order," or reports defects he is unable to remedy without delay.

He superintends the removal of the old primer and the inserting of a new one and the opening of the breech after a misfire, as prescribed in paragraphs 650 and 651.

During the loading he supervises the work of the gun details. When the gun is fully in battery he commands **READY** to the gun pointer.

At the command **DISMISSED** of the emplacement officer he commands **SECURE PIECE, FORM SECTION**. He supervises the replacing of equipments and implements, sees that the piece is secured, and then forms his section on the battery parade.

379.

12-inch gun (disappearing carriage.)

Details.	At command POSTS.	At command EXAMINE GUN.
Gun pointer (noncommissioned officer or private).	The gun pointer procures the sight, places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines and tests the traversing mechanism and the firing circuit.
Range setter (noncommissioned officer or private).	The range setter procures a stop watch and an abridged range table and takes post facing the range scale.	The range setter tests the range transmission apparatus and the elevating and retracting mechanisms. He cleans and oils the gears.
Breech detail: Chief of breech detail (noncommissioned officer or private), and Nos. 1, 2, 3, and 17.	The chief of breech detail takes post 2 yards in rear of the breech, facing it. No. 1 procures a wiper or cotton waste and a can containing synovial oil and a sponge. He places the can convenient to the breech and takes post about 1 yard to the rear and right of the breech, facing it. No. 2 procures a wiper or cotton waste and the loading tray, if one is used, places the tray convenient to the breech and takes post about 1 yard to the rear and left of the breech, facing it. No. 3 procures the lanyard, primer pouch, and holder containing punch and drill and takes post on the right side of the piece about 1 foot to the right and front of the elevating band, facing to the rear. No. 17 procures the operating crank for the breech mechanism, places it in position, and takes post about 2 feet to the right of the breech on line with its face, facing it.	The chief of breech detail examines the breech mechanism, breechblock, breech recess, chamber and bore, and gives the necessary orders for cleaning and putting them into condition for service. If the chamber or bore need sponging, he calls for the proper sponge and sponges the chamber, assisted by Nos. 1, 2, 3, 4 and 17, or the bore assisted by Nos. 1, 2, 3, 4, 5, 6, 7, 8, 16 and 17. Nos. 1 and 17 remove the breech cover and place it at the designated place. They clean and oil the breechblock and mechanism and assist in sponging the chamber and bore. No. 2 cleans and oils the breech recess and gas-check seat and assists in sponging the chamber and bore. No. 3 examines the safety lanyard device, firing attachment, vent, and lanyard. He clears the vent and cleans the primer seat. He coils the long lanyard and hangs it over the end of the elevating arm. He assists in sponging the chamber and bore.

379.

12-inch gun (disappearing carriage).

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
The gun pointer sets the deflection received and directs the traversing so that he will be on the target by the time the gun is in battery. He fires the piece or gives the command FIRE as soon after the command READY as the piece is pointed. He endeavors to locate the position of the splash of his shot and corrects his deflection if necessary.	No duties.
The range setter calls the deflection to the gun pointer and keeps the piece laid continuously for range in accordance with the transmitted information. He watches the time-range board and checks the laying of the piece with the information shown thereon.	No duties.
The chief of breech detail sees that the projectile is seated, commands HOME, RAM if it is not seated at the first attempt; he commands IN BATTERY in time to add the command TRIP as the breechblock begins to rotate, and hooks the safety lanyard during the rotation of the breechblock. After firing, he unhooks the lanyard as soon as the gun recoils within reach. No. 1 places the head of the rammer against the base of the projectile as the truck approaches the breech, assists in ramming the projectile, closes breech, and goes to his place on the rammer and stands by for the next shot. No. 2 wipes any residue from the gas-check seat and breech recess, inserts the loading tray, if used, as soon as the breech is opened: then takes his place on the rammer and assists in ramming; then steps to the left of the truck, picks up the third section of the powder charge and, as soon as the rammer is withdrawn after ramming home the first two sections, throws his section on to the truck and into the breech recess as far as possible; he removes the loading tray when used. No. 3 inserts a primer and lowers the leaf of the firing device <i>completely down</i>, steps back to the rear as the gun goes in battery, letting his lanyard uncoil, and pulls the lanyard at the command FIRE. After the piece is fired he coils the long lanyard, and as soon as the breech is opened removes the old primer, clears the vent and cleans the primer seat. No. 17 opens the breechblock, and cleans and oils it, when necessary. He assists No. 1 with the crank when there is difficulty in closing breech. If the projectile fails to seat at the first trial, he assists on the rammer.	The chief of breech detail supervises. No. 1 puts two sections of the dummy powder charge on the right powder tray of the truck and assists in withdrawing the dummy projectile. No. 2 puts two sections of the dummy powder charge on the left powder tray of the truck and assists in withdrawing the dummy projectile. No. 3 removes the primer. No. 17 opens breech and assists in withdrawing the dummy projectile.

379. 12-inch gun (disappearing carriage)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Rammer detail, Nos. 4, 16, and 18.	Nos. 4 and 16 procure the rammer and place it on the hooks outside the rail, head toward the hoist. No. 4 takes post about 2 yards from the head of the rammer, within reach of the staff, facing the piece. No. 16 takes post 4 yards to the right of No. 4, facing the piece. No. 18 takes post 4 yards to the left of No. 4, facing the piece.	No. 4 brings up the chamber sponge when called for and assists in sponging the chamber. Nos. 4 and 16 bring the bore sponge when called for and assist in sponging the bore. No. 18 removes the muzzle cover, hands it to No. 8, who places it at the designated place, and assists No. 9 in filling the recoil cylinders, passing up the oil measure and the funnel when needed.
Elevating detail, Nos. 5 and 6.	No. 5 procures the chamber sponge and No. 6 the extractors. They place them at the designated places and take posts at the elevating hand-wheel on the same side as the range setter, facing the piece.	Nos. 5 and 6 assist the range setter in testing the elevating and retracting mechanism, and clean and oil the gears. They assist in sponging the bore.
Traversing detail, Nos. 7 and 8.	Nos. 7 and 8 procure the traversing cranks, place them on the shaft, and take posts at the crank, on the same side as the gun pointer, facing to the rear.	Nos. 7 and 8 remove the drip pans, assist in testing the traversing mechanism, and in sponging the bore.
Tripping detail, Nos. 9 and 10.	No. 9 procures the wrench for filling plugs, the measure containing hydrolene oil, and the funnel, and goes to the right tripping lever. No. 10 procures a wrench for filling plugs and goes to the left tripping lever. After completing their duties at EXAMINE GUN they take posts facing the piece, by the platform railing, No. 9 one yard from No. 16 and No. 10 one yard from No. 18, toward No. 4.	Nos. 9 and 10 mount on the chassis, each carrying a wrench, and remove the filling plugs from the recoil cylinders. If oil is needed, No. 9 calls on No. 18 for the funnel and measure and pours oil into the right cylinder slowly. No. 10 watches the oil hole in the left cylinder. When both cylinders are full, No. 9 hands the funnel and measure back to No. 18 and notifies the gun commander that the cylinders are ready for inspection. After the inspection, Nos. 9 and 10 screw the plugs well home and replace their implements.

379. 12-inch gun (*disappearing carriage*)—Continued.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
Nos. 4, 16, and 18 assist in ramming the projectile; withdraw the rammer until its head is near the edge of the truck; ram the first two sections of the powder charge into the chamber as soon as they are put on the truck; same for the last two sections; go to the rear of the platform with the rammer and stand by for the next shot.	No. 4 brings up the extractor and pulls the dummy powder sections back on to the tray. After the dummy powder sections have been put on the powder trays he hooks the extractor into the dummy projectile and assists in withdrawing it. Nos. 16 and 18 assist in withdrawing the dummy projectile.
Nos. 5 and 6 elevate or depress the piece under direction of the range setter.	No duties.
Nos. 7 and 8 traverse the piece under direction of the gun pointer. They halt when the piece is fired and resume traversing as soon as the truck is withdrawn from the breech.	No duties.
Nos. 9 and 10 assist in ramming the projectile. As soon as the projectile is seated they quit the rammer and run to the tripping levers. At the command IN BATTERY they seize the tripping levers and at the command TRIP raise them quickly to the stop, hold them for an instant, then let go and run back to their posts at the rammer, where they stand by for the next shot. If firing by electricity, No. 9 (or No. 10) closes the safety switch while the piece is going into battery.	No duties unless the dummy projectile sticks, in which case they assist in starting it from its seat.

379. 12-inch gun (disappearing carriage)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Truck detail, Nos. 11 and 12.	Nos. 11 and 12 bring out the shot trucks to be used and turn them over to the hoist detail. When the first truck is loaded they push it to the loading position and take posts, No. 11 on the right, No. 12 on the left.	Nos. 11 and 12 examine the trucks and clean and oil them.
Hoist detail, Nos. 13, 14, and 15; No. 13 is chief of detail unless a noncommissioned officer is assigned in charge.	Nos. 13 and 14 procure the bore sponge and place it at the designated place. No. 15 procures the retraction cranks and places them on the hooks. All take posts at the delivery table.	Nos. 13, 14, and 15 examine and clean the delivery table.

379. 12-inch gun (*disappearing carriage*)—Continued.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
Nos. 11 and 12 run out a loaded shot truck, No. 12 adjusting the truck to the proper height in accordance with the position of the piece upon recoil. The truck is run forward so that the tray enters the breech recess squarely. As the truck brings up against the face of the breech No. 12 sets the brake. No. 11 then steps to the right side of the truck and No. 12 to the left, each picking up a section of the powder charge. As soon as the rammer is withdrawn after seating the projectile, No. 12 throws the first section of the charge on to the truck and into the breech recess as far as possible. No. 11 places a section of the charge in rear of the one thrown in by No. 12. No. 12 then steps back to the handle of the shot truck and No. 11 picks up the other section of powder charge from the right powder tray and, when the rammer is withdrawn, places it on the truck behind the section thrown into the breech recess by No. 12. Nos. 11 and 12 then return to the shot truck handles. As soon as the last two sections of the powder charge have been rammed, Nos. 11 and 12 withdraw the shot truck, run it back to the hoist, and turn it over to the hoist detail. Then they take posts behind a loaded truck and stand by for the next shot.	Nos. 11 and 12 push a truck into position at the breech to receive the dummy powder sections and dummy projectile, steady the truck until the dummy powder sections and dummy projectile have been withdrawn, then return the truck to the loading position.
Nos. 13, 14, and 15 receive the empty truck after each shot, load it, and run it out conveniently for Nos. 11 and 12.	No duties.

Notes on the drill.

380. The service of the piece as given above is for an emplacement with the ammunition hoist on the left side and a gun with an 1895 breech mechanism. If the hoist is on the right side of the emplacement, Nos. 1 and 4 are on the left side of the rammer staff in ramming the projectile. If the gun has an 1888 breech mechanism, the duties of the breech detail differ in the following respects: No. 1 assists in opening the breechblock, oils the threads, and assists in closing breech; No. 17 performs the duties in ramming, prescribed above for No. 1, and assists on the translating crank, if necessary. The chief of breech detail does not unhook the lanyard as the piece recoils.

381. To open breech, model 1888 mechanism.—No. 2 releases the rotating crank by turning the wing nut of the catch to the left and then turns the rotating crank clockwise, as indicated by the "open" arrow, until it brings up short in a horizontal position and is secured by its catch. No. 1 turns the translating crank briskly contraclockwise. When the shoulders of the grooves strike against the ends of the rails, the block stops short and the shock frees the tray latch from its catch; No. 1 swings the tray and block to the right until the securing latch engages in the catch.

382. To close breech.—No. 2 releases the securing latch from its catch; No. 1 swings the tray and block around to the left smartly; No. 2 seizes the handle of the tray and continues the swinging of the block until the tray abuts against and is latched to the face of the breech; then he turns the translating crank clockwise until the breech is translated completely; No. 1 releases the rotating crank by turning the wing nut and turns the rotating crank contraclockwise, as indicated by the "close" arrow, until it brings up short in a vertical position and is secured by its catch. If the loading tray is used, No. 2 removes it, releases the securing latch, places the loading tray on the loading platform, and then seizes the tray handle.

383. To open breech, model 1895 mechanism.—The chief of breech detail unhooks the lanyard from the eye of the firing leaf; No. 17 turns the crank continuously in a clockwise direction until the tray comes to rest against the hinge plate and the securing latch catches.

384. To close breech.—No. 1 releases the securing latch and turns the crank in a contraclockwise direction until the projecting shoulder on the rotating lug striking the gear prevents further motion. The latch should be released before the truck is withdrawn from the breech, holding the breechblock open by the operating crank until time to close it.

385. To load and fire.—The service of the piece at drill is conducted habitually as though a shot had just been fired. Before the command **LOAD** or **COMMENCE FIRING** is given the cannoneers are posted in the positions they would occupy

immediately after firing, No. 3 well back to the right and rear of the breech, with the lanyard extended; the chief of breech detail about 4 feet in rear of the breech; No. 17 on the right of the piece near the operating crank; the truck at the loading position; Nos. 1, 4, 9, and 16 on the right of the rammer, Nos. 10 and 18 on the left; Nos. 9, 10, 16, and 18 take hold as far to the rear as possible without interfering with each other; No. 4 takes hold about the center; No. 1 takes hold about 4 feet from the head, so as to guide it against the base of the projectile. At the command **LOAD** or **COMMENCE FIRING** the breech is opened and No. 2 wipes any residue from the breech recess and then takes his place on the rammer just in front of No. 10. Nos. 11 and 12 run up the truck; as it passes the rammer detail the head of the rammer is placed against the base of the projectile by No. 1, and the men on the rammer follow the truck, all taking a firm hold on the staff with both hands. As soon as the truck brings up against the face of the breech No. 12 sets the brake, and the men on the rammer run forward and seat the projectile with one motion and with the greatest possible force. The chief of breech detail notes if the projectile is seated; if not, he commands **HOME RAM**, and the men, all working together, heave on the rammer until the projectile is pushed home. As soon as the brake of the shot truck is set Nos. 11 and 12 step to the right and left of the truck, respectively, and each picks up one section of the powder charge. As soon as the projectile is seated Nos. 1, 2, 9, and 10 quit the rammer; No. 1 steps to the right side of the piece and prepares to close breech; No. 2 steps to the left of the truck and picks up a section of the powder charge; Nos. 9 and 10 run to the tripping bars and take hold of them, ready to trip; Nos. 4, 16, and 18 withdraw the rammer until the head is near the rear of the truck. As soon as the rammer is withdrawn No. 12 throws in the first section of the powder charge and No. 11 places the second section on the truck behind the first; Nos. 4, 16, and 18 ram these two sections well into the chamber; No. 12 steps back to the truck handle and No. 2 steps close to the breech with the third section of powder; No. 11 picks up the fourth section. As soon as the rammer is withdrawn after ramming the first two sections No. 2 throws in the third section of powder and No. 11 places the fourth section on the truck; Nos. 4, 16, and 18 ram these sections, then withdraw the rammer and carry it to the rear of the platform, standing by for the next loading. Nos. 11 and 12 remove the truck, take it back to the ammunition hoist, turn it over to the hoist detail, and take post at a loaded truck. During the loading No. 3 coils the long lanyard and serves the vent; No. 17 cleans and oils the threads of the breechblock and then stands ready to assist in closing breech. As soon as the truck is withdrawn the breech is closed by No. 1. The chief of breech detail commands **IN BATTERY** as the breechblock is being translated, and as soon as the

rotation begins he hooks the lanyard to the eye of the firing leaf and commands **TRIP**. No. 3 steps back to the right and rear, letting the long lanyard uncoil. Nos. 9 and 10 raise the tripping levers to the stop, then return to the rammer at a run and take post for the next loading.

386. The elevating and traversing details remain at their posts throughout the service of the piece. The elevating detail keeps the gun laid continuously in elevation. As soon as the truck is withdrawn from the breech the gun pointer directs the traversing of the piece so that the gun will be pointed at the target by the time it is fully in battery. The gun pointer fires by closing his firing key or gives the command **FIRE**, at the command **READY** of the gun commander, or as soon thereafter as he is able to point the piece properly. No. 3 pulls the lanyard with a strong, quick pull at the command **FIRE** of the gun pointer. As soon as the gun recoils the chief of breech detail springs in and unhooks the safety lanyard, the block is opened, and the operations described above are repeated.

387. The firing attachment is constructed so that the breech must be closed entirely before the leaf can be operated; therefore when practicable the lanyard should be hooked to the firing leaf before the breech is closed completely. In some cases, as with the 1888 breech mechanism, the lanyard can be left hooked to the eye of the firing leaf throughout the drill without interfering with the operation of opening and closing breech; the length of the safety lanyard, if used, should not be longer than will permit of this. With the 1895 mechanism, if the lanyard is left hooked, it is liable to be caught in the mechanism; therefore it should be unhooked as soon as the piece recoils within reach and hooked during the translation or rotation of the breech block. No. 3 should test the firing attachment by pulling on the leaf between shots to make sure it is functioning properly. After inserting the primer No. 3 must be careful to lower the slide of the firing attachment *completely down*; otherwise the primer may be blown back, endangering the lives of those in the rear and permitting the escape of powder gas, with consequent erosion of the vent.

388. With the 1895 breech mechanism it is convenient to fasten a wire around the piece back of the elevating band with a loop in which the safety lanyard may be hooked during the loading. The chief of breech detail after unhooking the lanyard swings it over the teeth of the breech mechanism and hooks it in the loop of the wire. Thus it is kept from being caught in the mechanism and is convenient to the chief of breech detail when the time comes to hook it again.

389. The breech detail should be taught to open breech promptly. The operation should begin as soon as the piece recoils within reach. A well-trained detail should have the breech nearly opened by the time the piece settles.

390. Experience has shown that an appreciable interval elapses between the command **TRIP** and the time the gun starts in battery. In normal fire action where the firing is as rapid

as possible the command **TRIP** may be given just as the breechblock begins to rotate. However, this command must *not* be given before the block is fully translated, as translation becomes difficult frequently, especially during sustained firing.

391. The rammer detail and the truck detail should be trained in their duties with the piece at different notches so as to secure uniformity in seating projectiles and rapidity in adjusting shot trucks under all conditions.

392. Prior to practice or action shot trucks should be adjusted to the highest point to which it is anticipated the gun will recoil, since the adjustment is made downward more easily and rapidly than upward.

393. The range setter must keep the piece laid continuously for range. If an observation is lost or the rate of change indicates an error he looks at the time-range board and controls the setting in accordance with the information indicated thereon. Many guns change in elevation during recoil; in such cases the range setter should return the piece to the proper elevation and take up the time range relation as promptly as possible.

394. In withdrawing a dummy projectile care should be taken to draw it back on the truck and against the stop gently.

395. If the gun fails to go in battery completely, the gun commander orders Nos. 9, 10, 16, and 18 to use the pinch bars; these are engaged in the notches on the chassis and the gun is forced into battery. However, battery commanders should observe such defects at daily drill and have the same remedied before practice or action.

396. Care should be taken by Nos. 2, 11, and 12 that the sections of powder charges, when thrown on the truck in loading, are lined up properly and placed so that when rammed they will not jam in the breech recess.

397. When trucks are not provided with brakes Nos. 11 and 12 chock the wheels as soon as the truck reaches the breech.

398. For carriages provided with electric motors the gun pointer operates the traversing controller and the range setter the elevating and retracting controller.

399. When traversing by electricity the traversing cranks are left on and Nos. 7 and 8 stand by to spring to their posts on orders from the gun pointer in case of failure of the electric power.

400. The range setter operates the maneuver lever and is responsible that it is never left untended. In changing its setting he must be careful to mesh the gears properly.

401. The members of the gun section should be trained to work together with the utmost celerity and precision and without interfering with one another. When they become proficient the interval between the commands **LOAD** and **TRIP** should not exceed twenty to twenty-five seconds, as a rule, with service charge, the charge on a truck and the breech

closed at the command **LOAD**; with dummy ammunition this time should be about five seconds less.

402. To retract the gun.—To bring the gun from the firing to the loading position the gun commander commands **FROM BATTERY, HEAVE, HALT, CAST OFF**. At the first command Nos. 7 and 8 go to the retraction cranks. No. 7 releases the retaining pawl and turns the speed crank to permit the pulling out of the ropes. Nos. 9 and 10 mount on the gun levers and place the ends of the ropes on the hooks, receiving them from Nos. 17 and 4, who mount on the chassis to assist. Nos. 1 and 2 pull out the ropes and pass the ends to Nos. 17 and 4; No. 7 takes in the slack. Nos. 7, 8, 9, and 10 take positions at the retraction cranks, and at the second command turn them. Nos. 3, 4, 6, and 17 relieve Nos. 7, 8, 9, and 10 when directed by the gun commander. Odd numbers work on the right side of the carriage, even numbers on the left. When the gun has reached the loading position the command **HALT** is given. At the command **CAST OFF** No. 7 lets out enough slack to enable Nos. 1 and 2 to take the rope ends off the hooks. In retracting the gun by electric power the range setter operates the controller. At the first command he sets the maneuver lever for retracting and lets out slack to permit the cables to be pulled out. At the second command he operates the retracting motor, taking care that the gun levers do not strike the recoil buffers. At the third command he stops the motor, lets out enough slack for the removal of the ends of the ropes, sets the index to *off* and *throws the idler out of gear for retraction*. To prevent injury to the ropes by reverse winding in letting out slack, the chief of breech detail takes a position where he can see one of the drums and stops the unwinding before the last turn of the rope is off the drum. To prevent injury to the ropes by winding across the grooves in taking up slack, No. 1 watches the right drum and No. 2 the left until the ropes are taut; if either rope fails to wind in the proper groove the man on that side calls **HALT**; whereupon the winding is stopped and the rope adjusted, by No. 9 if on the right drum, by No. 10 if on the left. In retracting, the ropes should be under equal tension. Slight adjustments may be made by twisting one of the ropes, but appreciable differences in lengths must be adjusted at the drums.

Ammunition service.

403. The chief of ammunition service is in charge of the ammunition section and of the galleries and magazines of the battery.

He is responsible for the condition of the projectiles, trolleys, and hoists and for the police of the galleries and magazines. On the arrival of his section at the emplacement he commands **DETAILS, POSTS**. When the details are posted he makes an inspection of the trolleys, hoists, magazines, and galleries and reports to the emplacement officer, "Sir, ammu-

nition service, No. ——— in order," or reports defects he is unable to remedy without delay. During drill or action he supervises the service of ammunition.

At the command **DISMISSED** of the emplacement officer he commands **SECURE MAGAZINES, FORM SECTION**. He sees that all his apparatus is in order, doors locked, and supervises the formation of his section.

404. The projectile details for each emplacement are assigned to the hoists and trolleys as the installation requires and transfer projectiles to the delivery tables as ordered.

405. The powder details for each emplacement are assigned for the service of powder as the installation requires. When no separate powder hoists are installed powder sections are carried to the loading platforms by members of the powder details.

10-INCH GUN BATTERY, DISAPPEARING CARRIAGE.

406. The organization at the emplacement and the duties of the officers, gun commander, and mechanics are the same as prescribed for a 12-inch gun battery, disappearing carriage.

407. The gun section consists of 18 enlisted men, and the ammunition section approximately 22 enlisted men for a two-gun battery.

408.

10-inch gun (disappearing carriage).

Details.	At command POSTS.	At command EXAMINE GUN.
Gun pointer(non-commissioned officer or private).	The gun pointer procures the sight and places it in its seat and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines and tests the traversing mechanism and the firing circuit.
Range setter(non-commissioned officer or private).	The range setter procures a stop watch and an abridged range table and takes post facing the range scale.	The range setter tests the range transmission apparatus and the elevating and retracting mechanisms. He cleans and oils the gears.
Breech detail: Chief of breech detail (noncommissioned officer or private), and Nos. 1, 2, and 3.	The chief of breech detail takes post two yards in rear of the breech, facing it. No. 1 procures a wiper or cotton waste and a can containing synovial oil and a sponge. He places the can convenient to the breech and takes post about 1 yard to the rear and right of the breech, facing it. No. 2 procures a wiper or cotton waste and the loading tray, if one is used, places the tray convenient to the breech and takes post about 1 yard to the rear and left of the breech, facing it. No. 3 procures the lanyard, primer pouch, and holder containing punch and drill and takes post on the right side of the piece about 1 foot to the right and front of the elevating band, facing to the rear.	The chief of breech detail examines the breech mechanism, breech block, breech recess, chamber, and bore, and gives the necessary orders for cleaning and putting them into condition for service. If the chamber or bore need sponging he calls for the proper sponge and sponges the chamber, assisted by Nos. 1, 2, 3, and 4, or the bore, assisted by Nos. 1, 2, 3, 4, 5, 6, 7, and 8. No. 1 removes the breech cover and places it at the designated place. He cleans and oils the breech block and mechanism and assists in sponging the chamber and bore. No. 2 cleans and oils the breech recess and gas-check seat and assists in sponging the chamber and bore. No. 3 examines the safety lanyard device, firing attachment, vent, and lanyard. He clears the vent and cleans the primer seat. He coils the long lanyard and hangs it over the end of the elevating arm. He assists in sponging the chamber and bore.

408.

10-inch gun (disappearing carriage).

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
The gun pointer sets the deflection received and directs the traversing so that he will be on the target by the time the gun is in battery. He fires the piece or gives the command FIRE as soon after the command READY as the piece is pointed. He endeavors to locate the position of the splash of his shot and corrects his deflection if necessary.	No duties.
The range setter calls the deflection to the gun pointer and keeps the piece laid continuously for range in accordance with the transmitted information. He watches the time-range board and checks the laying of the piece with the information shown thereon.	No duties.
The chief of breech detail sees that the projectile is seated, commands HOME, RAM if it is not seated at the first attempt; he commands IN BATTERY in time to add the command TRIP when the safety lanyard is hooked by No. 3. Nos. 1 and 2 open the breech. No. 1 cleans and oils the breechblock when necessary, steadies the head of the rammer against the base of the projectile as the truck approaches the breech, and assists in ramming the projectile. He picks up the second section of the powder charge and throws it on to the truck and, assisted by No. 2, pushes it into the chamber by hand until its base barely clears the gas-check seat. He closes breech, assisted by No. 2. No. 2 wipes any residue from the gas-check seat and breech recess, inserts the loading tray, if used, as soon as the breech is opened; then takes his place on the rammer and assists in ramming the projectile and first section of the powder charge. He assists No. 1 in pushing the second section into the chamber by hand, removes the loading tray, if used, and assists No. 1 in closing breech. No. 3 inserts a primer and lowers the leaf of the firing device completely down, hooks the safety lanyard during the rotation of the breechblock, steps back to the right and rear as the gun goes into battery, letting his lanyard uncoil and pulls the lanyard at the command FIRE. After the piece is fired he coils the long lanyard, unhooks the lanyard as soon as the gun recoils within reach; as soon as the breech is opened, removes the old primer, cleans the vent and cleans the primer seat.	The chief of breech detail supervises; Nos. 1 and 2 open breech. No. 1 puts the first section of the dummy powder charge on the right powder tray of the truck and assists in withdrawing the dummy projectile. No. 2 puts the second section of the dummy powder charge on the left powder tray of the truck and assists in withdrawing the dummy projectile. No. 3. No duties.

408. 10-inch gun (*disappearing carriage*)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Rammer detail, No. 4.	No. 4 procures the rammer and places it on its hooks outside the rail, head toward the hoist, and takes post about 6 feet from the head of the rammer, within reach of the staff, facing the piece.	No. 4 brings up the chamber or bore sponge when called for and assists in sponging the chamber and bore.
Elevating detail, Nos. 5 and 6.	No. 5 procures the chamber sponge and No. 6 the extractor. They place them at the designated places and take posts at the elevating handwheel on the same side as the range setter, facing the piece.	Nos. 5 and 6 assist the rangesetter in testing the elevating and retracting mechanism, and clean and oil the gears. They assist in sponging the bore.
Traversing detail, Nos. 7 and 8.	Nos. 7 and 8 procure the traversing cranks, place them on the shaft, and take posts at the crank, on the same side as the gun pointer, facing to the rear.	Nos. 7 and 8 remove the drip pans, assist in testing the traversing mechanism and in sponging the bore. No. 8 receives the muzzle cover from No. 11 and places it at the designated place.
Tripping detail, Nos. 9 and 10.	No. 9 procures a wrench for filling plugs, the measure containing hydrolene oil, and the funnel, and goes to the right tripping lever. No. 10 procures a wrench for filling plugs and goes to the left tripping lever. After completing their duties at EXAMINE GUN they take posts, facing the piece, by the platform railing, No. 9 one yard to the right of No. 4 and No. 10 one yard to the left of No. 4.	Nos. 9 and 10 mount on the chassis, each carrying a wrench, and remove the filling plugs from the recoil cylinders. If oil is needed, No. 9 calls on No. 11 for the funnel and measure and pours oil into the right cylinder slowly. No. 10 watches the oil hole in the left cylinder. When both cylinders are full No. 9 hands the funnel and measure back to No. 11 and notifies the gun commander that the cylinders are ready for inspection. After the inspection Nos. 9 and 10 screw the plugs well home and replace their implements.

408. 10-inch gun (*disappearing carriage*)—Continued.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
No. 4 brings up the rammer and places its head against the base of the projectile and moves forward with the truck, and, assisted by Nos. 1, 2, 9, and 10, rams the projectile; withdraws the rammer until its head is near the rear of the truck, assisted by No. 2 rams the first section of the powder charge into the chamber as soon as it is put on the truck, and goes to the rear of the platform with the rammer and stands by for the next shot.	No. 4 brings up the extractor and pulls the dummy powder sections back on to the truck. After the dummy powder sections have been put on the powder trays he hooks the extractor into the dummy projectile and assists in withdrawing it.
Nos. 5 and 6 elevate or depress the piece under direction of the range setter.	No duties.
Nos. 7 and 8 traverse the piece under direction of the gun pointer. They halt when the piece is fired and resume traversing as soon as the truck is withdrawn from the breech.	No duties.
Nos. 9 and 10 assist in ramming the projectile. As soon as the projectile is seated they quit the rammer and run to the tripping levers. At the command IN BATTERY they seize the tripping levers, and at the command TRIP, raise them quickly to the stops, hold them for an instant, then let go, and when the gun is in battery run back to their posts at the rammer, where they stand by for the next shot. If firing by electricity, No. 9 (or 10) closes the safety switch while the piece is going into battery.	No duties unless the dummy projectile sticks, in which case they bring up the screw extractor and wrench, start the projectile from its seat and withdraw it.

408. 10-inch gun (*disappearing carriage*)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Truck detail, Nos. 11 and 12.	Nos. 11 and 12 bring out the shot trucks to be used and turn them over to the hoist detail. When the first truck is loaded they push it to the loading position and take posts No. 11 on the right, No. 12 on the left.	No. 11 removes the muzzle cover, hands it to No. 8, and assists No. 9 in filling the recoil cylinders, passing up the oil measure and the funnel when needed. Nos. 11 and 12 examine the trucks and clean and oil them.
Hoist detail, Nos. 13, 14, and 15; No. 13 is chief of detail unless a noncommissioned officer is assigned in charge.	Nos. 13 and 14 procure the bore sponge and place it at the designated place. No. 15 procures the retraction cranks and places them on the hooks. All take posts at the delivery table.	Nos. 13, 14, and 15 examine and clean the delivery table.

408. 10-inch gun (*disappearing carriage*)—Continued.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
Nos. 11 and 12 run out a loaded shot truck, No. 12 adjusting the truck to the proper height in accordance with the position of the piece upon recoil. As the truck brings up against the face of the breech No. 12 sets the brake. No. 12 picks up the first section of the powder charge and as soon as the rammer is withdrawn after seating the projectile he throws the first section of the charge on to the truck and into the breech recess as far as possible and returns to the shot truck handle. As soon as the second section of the powder charge has been pushed into the chamber Nos. 11 and 12 withdraw the shot truck, run it back to the hoist, and turn it over to the hoist detail. Then they take posts behind a loaded truck and stand by for the next shot.	Nos. 11 and 12 push a truck into position at the breech to receive the dummy powder sections and dummy projectile, steady the truck until the dummy powder sections and dummy projectile have been withdrawn, then return the truck to the loading position.
Nos. 13, 14, and 15 receive the empty truck after each shot, load it, and run it to the loading position.	No duties.

Notes on the drill.

409. Paragraphs 381, 382, 384, 386 to 394, inclusive, 396 to 401, inclusive, and 403 to 405, inclusive, apply to the drill for this gun.

410. Paragraphs 385 and 395 apply to the drill for this gun except reference to Nos. 16 and 18.

411. Paragraphs 383 and 402 apply to the drill for this gun except that No. 3 performs the duties prescribed for No. 17, and that the retraction crank is manned by Nos. 7 and 8, who are relieved by Nos. 9 and 10 when directed by the gun commander.

8-INCH GUN BATTERY, DISAPPEARING CARRIAGE.

412. The organization at the emplacement and the duties of the officers, gun commanders, and mechanics are as prescribed for a 12-inch gun battery, disappearing carriage.

413. The gun section consists of 17 enlisted men, and the ammunition section of approximately 20 enlisted men for a two-gun battery.

414. The drill is the same as that prescribed for a 10-inch gun battery, except that the chief of breech detail is omitted and his duties are performed by No. 1, and except that reference to the second section of the powder charge is omitted.

415. The notes on the drill for the 10-inch gun apply to this gun also.

6-INCH GUN BATTERY, DISAPPEARING CARRIAGE.

416. The organization at the emplacements is similar to that for a 12-inch gun battery disappearing carriage.

417. The duties of the officers and chiefs of sections are similar to those prescribed for a 12-inch gun battery disappearing carriage.

418. The emplacements are in charge of an emplacement officer, or officers when there are more than two emplacements, and each gun is manned by a gun section (12 enlisted men), consisting of a gun commander (a noncommissioned officer), a gun pointer (a noncommissioned officer or private), a range setter (a noncommissioned officer or private), and 9 privates. The ammunition section (approximately 7 enlisted men for each emplacement) consists of a chief of ammunition service (a noncommissioned officer) and details for each gun of the battery, each detail to consist of such noncommissioned officers and privates as the installation requires.

419.

6-inch gun (disappearing carriage).

Details.	At command POSTS.	At command EXAMINE GUN.
Gun pointer (non-commissioned officer or private).	The gun pointer procures the sight and places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines and tests the traversing mechanism and the firing circuit.
Range setter (noncommissioned officer or private).	The range setter procures a stop watch and an abridged range table and takes post facing the range scale.	The range setter tests the range transmission apparatus and the elevating and retracting mechanism. He cleans and oils the gears.
Breech detail, Nos. 1, 2, and 3; No. 1 is chief of detail.	No. 1 procures a wiper or cotton waste and a can containing synovial oil and a sponge. He places the can convenient to the breech and takes post about 2 feet to the rear and right of the breech facing it. No. 2 procures a wiper or cotton waste and the loading tray (if one is used), places the tray convenient to the breech, and takes post about 2 feet to the rear and left of the breech, facing it. No. 3 procures the lanyard, primer pouch, and holder containing punch and drill, and takes post about 2 feet to the right of the breech on line with its face, facing it.	No. 1 removes the breech cover and places it at the designated place. He examines the chamber and bore and cleans and oils the breech-block and mechanism. If the chamber or bore need sponging, he calls for the proper sponge and sponges the chamber, assisted by No. 4, or the bore, assisted by Nos. 2, 3, and 4. No. 2 examines the breech recess and gas-check seat, cleans and oils them, and assists in sponging the bore. No. 3 examines the lanyard, firing attachment, and vent. He clears the vent and cleans the primer seat. He assists in sponging the bore.
Rammer detail, No. 4.	No. 4 procures the rammer and takes post about 4 feet in rear of the breech, facing it. He holds the rammer in his right hand, rammer in a vertical position, its head on the platform by his right foot.	No. 4 lays aside the rammer and brings up the proper sponge when it is called for, and assists in sponging.
Projectile detail, Nos. 5 and 6.	No. 5 takes post near the serving table. No. 6 procures the chamber sponge and extractor, places them at the designated place, and takes post near the serving table.	No. 5 assists No. 9 in filling the recoil cylinders. No. 6 removes the muzzle cover and places it at the designated place. He assists the range setter in examining the elevating and retracting mechanisms and cleans and oils the gears.

419.

6-inch gun (disappearing carriage).

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
The gun pointer sets the deflection received and as soon as the truck is withdrawn from the breech follows the target continuously. He fires the piece (or gives the command FIRE) as soon after the command READY as the gun is pointed. He endeavors to locate the splash of his shot and corrects his deflection, if necessary.	No duties.
The range setter calls the deflection to the gun pointer and keeps the piece laid continuously for range in accordance with the transmitted information. He watches the time-range board and checks the laying of the piece with the information shown thereon.	No duties.
No. 1 opens breech, cleans and oils the block, when necessary, and as soon as the powder charge has been inserted, closes breech and commands TRIP. He seizes the lever handle as soon as possible after the piece is fired and opens breech for the next shot. No. 2 receives a powder charge from No. 7 (or No. 8), inserts it as soon as the rammer is withdrawn, and wipes out the breech recess, if necessary. If a separate loading tray is used he inserts it as soon as the breech is opened and withdraws it after inserting the powder charge. No. 3 inserts a primer and lowers the leaf of the firing device <i>completely down</i>. He hooks the lanyard, sees that it is kept on the right-hand side of the breech lever so it will not become entangled in the mechanism in closing breech. As the gun goes in battery he steps to the rear and right and pulls the lanyard at the command FIRE. He unhooks the lanyard and removes the old primer as soon as the breech is opened, and cleans the primer seat.	No. 1 opens breech. No. 2 withdraws the dummy powder charge and passes it to No. 7 (or No. 8). No. 3 removes the primer.
No. 4 rams the projectile home with all possible force as soon as it is launched on the loading tray.	No. 4 brings up the extractor and pulls the dummy projectile back on the loading tray.
No. 5 picks up a projectile from the serving table and launches it on the loading tray as soon as the breech is opened. No. 6 arranges the projectiles on the serving table and keeps the table convenient to the breech.	No. 5 removes the dummy projectile from the loading tray and places it on the serving table. No. 6. No duties.

419. 6-inch gun (disappearing carriage)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Powder detail, Nos. 7 and 8.	Nos. 7 and 8 take posts most convenient for the service of powder.	Nos. 7 and 8 remove the drip pans.
Tripping detail, No. 9.	No. 9 procures the wrench for filling plugs, the measure containing hydrolene oil, and the funnel, and takes post at the right tripping lever if the safety switch is on the right of the carriage, or at the left tripping lever if the switch is on the left.	No. 9 unscrews the filling plugs, and if oil is needed he calls on No. 5 for the funnel and measure, pours oil into the right cylinder slowly, and when both cylinders are full hands the funnel and measure back to No. 5 and notifies the gun commander that the cylinders are ready for inspection. After the inspection No. 9 screws the plugs well home and replaces his implements.

419. *6-inch gun (disappearing carriage)*—Continued.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
Nos. 7 and 8 alternate in bringing up powder charges and passing them to No. 2.	No. 7 (or No. 8) receives the dummy powder charge from No. 2.
No. 9 raises the tripping levers at the command TRIP of No. 1, and if firing by electricity closes the safety switch while the piece is going into battery.	No duties.

Notes on the drill.

420. To load and fire.—As the piece recoils from battery No. 1 seizes the handle of the breech lever as soon as he can reach it, opens the breech and wipes off the block, oiling the threads if necessary. No. 5 picks up a projectile from the serving table and launches it on the tray as soon as the breech is opened, and No. 4 rams it home and withdraws the rammer with life. No. 6 keeps the projectiles piled properly on the serving table and keeps the serving table in a position convenient to the breech. No. 2, who has received a powder charge from No. 7 (or 8), steps close to the breech, and immediately after the rammer is withdrawn inserts the powder charge. No. 1 grasps the handle of the lever while the charge is being inserted, closes the breech with one motion, and commands **TRIP**. No. 9 raises the tripping lever, and when the gun is nearly in battery closes the safety switch, if firing by electricity. No. 3 serves the vent while the breech is opened, being careful to keep the lanyard clear of the mechanism if firing by lanyard. The gun commander commands **READY** when the gun is in battery. The gun pointer follows the target continuously during loading, and the range setter keeps it laid continuously for range. The gun pointer closes the firing key or commands **FIRE** at the command **READY** of the gun commander, or as soon thereafter as the gun is pointed. No. 3 pulls the lanyard at the command **FIRE**.

421. To retract the gun.—To bring the gun from the firing to the loading position the gun commander commands **FROM BATTERY, HEAVE, HALT, CAST OFF**. At the first command No. 9 goes to the retraction crank and operates the pawl and speed crank to permit the pulling out of the ropes. Nos. 5 and 6 mount on the carriage and place the loops of the ropes on the hooks. Nos. 1 and 2 pull out the the ropes and pass the ends to Nos. 5 and 6. No. 9 takes in the slack. Nos. 7 and 8 take position at the retraction crank and at the second command turn the crank. Nos. 5 and 6 relieve Nos. 7 and 8 when directed by the gun commander. When the gun has reached the loading position the command **HALT** is given. At the command **CAST OFF**, No. 9 lets out enough slack to enable Nos. 1 and 2 to take the loops off the hooks. To prevent injury to the ropes the same precautions are observed as with the 12-inch gun, paragraph 402.

422. Additional numbers 10 and 11 should be supplied when difficulty is experienced in keeping the supply of ammunition up to the maximum speed of loading.

423. A well-trained section should be able to maintain a rate of fire of six shots per minute.

424. In the service of ammunition the projectile detail delivers the projectiles to the serving table, and the powder details secure the charges and deliver them to Nos. 7 and 8 of the gun section at the edge of the loading platform.

12-INCH GUN BATTERY, BARBETTE CARRIAGE.

425. The organization at the emplacements is the same as that for a 12-inch gun battery, disappearing carriage.

426. Each gun is manned by a gun section (22 enlisted men), consisting of a gun commander (a noncommissioned officer), a gun pointer (a noncommissioned officer or private), a range setter (a noncommissioned officer or private), a chief of breech detail (a noncommissioned officer or private), and 18 privates.

427. The ammunition section (approximately 30 enlisted men) consists of a chief of ammunition service (a noncommissioned officer) and details for each gun of the battery, each detail to consist of such noncommissioned officers and privates as the installation requires.

428. The duties of the officers and chiefs of section are similar to those prescribed for a 12-inch gun battery, disappearing carriage.

429.

12-inch gun (barbette carriage).

Details.	At command POSTS.	At command EXAMINE GUN.
Gun pointer.	The gun pointer procures the sight, places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines and tests the traversing mechanism and the firing circuit.
Range setter (noncommissioned officer or private).	The range setter procures a stop watch and an abridged range table and takes post facing the range scale.	The range setter tests the range transmission apparatus and the elevating mechanism.
Breech detail: Chief of breech detail (noncommissioned officer or private), Nos. 1, 2, 3.	The chief of breech detail takes post 1 yard in rear of No. 2. No. 1 procures the operating crank (1895 mechanism) or the translating roller (1888 mechanism), a wiper or cotton waste, and a can containing synovial oil and a sponge; he places the can convenient to the breech, the operating crank or roller in position, and takes post on the loading platform immediately to the rear and right of the breech, facing it. No. 2 procures a wiper or cotton waste and the loading tray; he places the tray convenient to the breech and takes post on the left of No. 1, facing the breech. No. 3 procures the lanyard, primer pouch, holder containing punch and drill, and takes post on the platform at the right of the breech, facing it.	The chief of breech detail examines the breech mechanism, breechblock, breech recess, chamber, and bore, and gives the necessary orders for cleaning and putting them into condition for service. If the chamber or bore need sponging he calls for the proper sponge and sponges the chamber, assisted by the other members of the breech detail and No. 4, or the bore assisted by Nos. 4, 5, 6, 7, 8, and 16. No. 1 removes the breech cover and passes it to No. 4. He cleans and oils the breechblock and mechanism and assists in sponging the chamber. No. 2 cleans and oils the breech recess and gas-check seat and assists in sponging the chamber. No. 3 examines the safety-lanyard device, firing attachment, vent, and lanyard. He clears the vent and cleans the primer seat. He frees the lanyard of kinks and hangs it on a hook outside the platform rail on the right side of the carriage. He assists in sponging the chamber.

429.

12-inch gun (barbette carriage).

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
The gun pointer sets the deflection received and directs the traversing so as to follow the target continuously. He fires the piece or gives the command FIRE as soon after the command READY as the piece is pointed. He endeavors to locate the position of the splash of his shot and corrects his deflection if necessary.	No duties.
The range setter calls the deflection to the gun pointer. He directs the work of Nos. 5 and 6, requiring the piece to be given a depression $1^{\circ} 15'$ as soon as fired and to be elevated during the operation of closing the breech. He calls "Range set" as soon as the range is set properly, and thereafter directs the elevation or depression of the piece so that it will be laid continuously in elevation. He watches the time-range board and checks the laying of the piece with the information shown thereon.	The range setter directs the piece to be given a depression of $1^{\circ} 15'$.
The chief of breech detail commands RAM as soon as the projectile is in position, and after it has been launched into the chamber he commands HOME RAM. He assists in ramming the projectile and the sections of powder, and passes the lanyard to No. 4. He hooks the safety lanyard during the rotation of the breechblock. He steps to the side of the platform clear of the recoil and after firing unhooks the lanyard. No. 1 receives the rammer and places its head against the base of the projectile, assists in ramming the projectile, puts in the second and fourth sections of the powder charge, closes breech (1895 mechanism), and during firing steps to the side of the platform clear of the recoil. No. 2 wipes any residue from the gas-check seat and breech recess, inserts the loading tray as soon as the breech is open, swings the projectile into position, takes his place on the rammer, and assists in ramming. He inserts the first and third sections of the powder charge, pushing them into the chamber as far as possible, and removes the loading tray. During firing he steps to the side of the platform clear of the recoil. No. 3 opens breech (1895 mechanism), inserts the primer, and lowers the leaf of the firing device <i>completely down</i> and steps clear of the recoil. As soon as the breech is opened after the piece is fired he removes the old primer, clears the vent, and cleans the primer seat.	The chief of breech detail supervises. No. 1 passes the first and third dummy sections of powder to No. 10 and assists in withdrawing the dummy projectile. No. 2 inserts the loading tray, passes the second and fourth dummy sections of powder to No. 17, assists in withdrawing the dummy projectile and assists in swinging the loaded shot tray clear of the platform. No. 3 opens breech, removes the primer, and assists in withdrawing the dummy projectile.

429. 12-inch gun (*barbette carriage*)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Rammer detail, Nos. 4 and 16.	Nos. 4 and 16 procure the rammer, place it on the prop, and take post in rear of the loading platform, No. 4 on the right and No. 16 on the left.	No. 4 passes up the chamber sponge when called for and assists in sponging. No. 16 assists in sponging the bore.
Elevating detail, Nos. 5 and 6.	No. 5 procures the chamber sponge, places it at the designated place, and takes post at the elevating handle on the right side of the piece, facing it. No. 6 procures the extractor, places it at the designated place, and takes post at the elevating handle on the left side of the piece, facing it.	Nos. 5 and 6 pass up the bore sponge when called for and assist in sponging the bore. They assist the range setter in testing the elevating mechanism, and clean and oil the gears.
Traversing detail, Nos. 7 and 8.	Nos. 7 and 8 procure the traversing cranks, place them on the shaft, and take post at the crank on the same side of the piece as the gun pointer, facing to the rear.	Nos. 7 and 8 remove the drip pans and assist in testing the traversing mechanism and in sponging the bore.
Hoist tackle detail, Nos. 9, 10, 17, and 18; No. 9 is chief of detail unless a noncommissioned officer is assigned in charge.	No. 9 procures the wrench for filling plugs, the measure containing hydrolene oil, and the funnel, and takes post opposite the hoist tackle, 1 yard from and facing the piece. No. 10 procures a wrench for filling plugs and takes post in rear of the windlass crank handle, facing it.	Nos. 9 and 10 mount on the chassis, each carrying a wrench, and remove the filling plugs from the recoil cylinders. If oil is needed, No. 9 calls on No. 18 for the funnel and measure and pours oil into the right cylinder slowly; No. 10 watches the oil hole in the left cylinder. When both cylinders are full No. 9 hands the funnel and measure back to No. 18 and notifies the gun commander that the cylinders are ready for inspection. After the inspection Nos. 9 and 10 screw the plugs well home and replace their implements.

429.

12-inch gun (barbette carriage)—Continued.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
No. 4 mounts on the loading platform and assists in ramming the projectile, wipes off the breechblock and oils the threads, dismounts, takes the end of the lanyard, and pulls it at the command FIRE. No. 16 holds the rammer so that it may be seized by No. 1. He mounts on the loading platform, assists in ramming the projectile and the powder section, then dismounts, taking the rammer with him.	No. 4 receives the extractor from No. 16, mounts on the platform, pulls back the dummy powder sections, assists in withdrawing the dummy projectile, and returns the extractor to No. 16. No. 16 mounts on the platform, assists in withdrawing the dummy projectile, dismounts, and receives the extractor from No. 4.
Nos. 5 and 6 elevate and depress the piece under direction of the range setter.	Nos. 5 and 6 depress the piece as directed by the range setter.
Nos. 7 and 8 traverse the piece under direction of the gun pointer. If firing by electricity, No. 8 closes the safety switch as the piece is being elevated.	No duties.
No. 9 hooks the hoist tackle to a shot tray, commands HOIST, steadies the projectile as it rises, mounts the steps with it, commands HALT when the projectile is at the height of the breech. He assists in swinging the projectile around to the breech and swings the shot tray clear of the loading platform after the projectile has been rammed. He commands LOWER, guides the shot tray on to the truck and unhooks the tackle. He directs the work of the hoist detail so as to have a projectile hoisted to the proper height by the time the piece is fired.	No. 9 swings the shot tray to its position at the breech, assists in swinging it clear of the carriage, and commands LOWER at the proper time.

429.

12-inch gun (*barbette carriage*)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
	No. 17 takes post on the left of No. 10. No. 18 takes post in front of the windlass-crank handle, facing it.	No. 17 examines the tackle on hoisting gear and cleans and oils the parts. No. 18 removes the muzzle cover, places it at the designated place, and assists No. 9 in filling the recoil cylinders, passing up the oil measure and funnel when needed.
Truck detail, Nos. 11 and 12.	Nos. 11 and 12 bring out the shot trucks to be used and turn them over to the hoist detail. When the first truck is loaded they push it to a position immediately under the hoisting tackle on the carriage. They return to the ammunition hoist and push to the piece a second truck loaded with a projectile, and take posts at the handles of the first truck, No. 11 on the right, No. 12 on the left.	Nos. 11 and 12 examine the trucks and clean and oil them.
Hoist detail, Nos. 13, 14, and 15; No. 13 is chief of detail unless a noncommissioned officer is assigned in charge.	Nos. 13 and 14 procure the bore sponge and place it at the designated place. No. 15 procures the retraction cranks and places them on the hooks. All take post at the delivery table.	Nos. 13, 14, and 15 examine and clean the delivery table.

429.

12-inch gun (barbette carriage)—Continued.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
Nos. 10 and 17 assist in hoisting the projectile. No. 18 assists in hoisting the projectile, lowers the shot tray, and attends to the pawl.	Nos. 10, 17, and 18 lower the dummy projectile on to the truck.
As soon as the first projectile is hoisted, Nos. 11 and 12 pull the truck aside and push the second truck under the hoist tackle. Then they return with the empty truck to the ammunition hoist, turn it over to the ammunition-hoist detail, and take post behind a loaded truck. As soon as the piece is fired they run this truck rapidly to the position described under "Posts" for the second truck, pull the empty truck away from the hoisting tackle, and proceed as above.	Nos. 11 and 12 push a truck into position under the hoist tackle, receive the dummy powder sections from Nos. 1 and 2, and place them on the powder trays of the truck.
Nos. 13, 14, and 15 receive the empty truck after each shot, load it, and run it out conveniently for Nos. 11 and 12.	No duties.

Notes on the drill.

430. To open and close breech.—The operations of opening and closing breech are as prescribed in the drill for the 12-inch gun on disappearing carriage, except that the breech must not be opened until the piece has been given a depression of $1^{\circ} 15'$; when open the breechblock must be swung to the left about halfway before the piece can be elevated.

431. To load and fire.—The service of the piece at drill is conducted habitually as though a shot had just been fired. Before the command **LOAD** or **COMMENCE FIRING** is given the cannoneers are posted in the positions they would occupy immediately after firing. Those who remain on the loading platform are posted at the sides of the platform clear of the recoil. No. 4 is well back to the right and rear of the gun platform with the lanyard extended. No. 9 is on the loading platform by the hoisting tackle, on which are suspended a tray and projectile at the height necessary for loading. At the command **LOAD** or **COMMENCE FIRING** the piece is depressed rapidly. The chief of breech detail springs in and unhooks the lanyard, then steps back to the rammer staff; No. 3 opens breech. While the breech is being opened Nos. 9 and 2 swing the projectile to its position at the breech; No. 4 tosses the long lanyard over the right rail of the loading platform and mounts on the platform. No. 1 receives the rammer from No. 16, who mounts on the platform, and the chief of breech detail, Nos. 1, 4, and 16, stand ready to ram. As soon as the projectile is at the breech, No. 1 places the head of the rammer against the base of the projectile, No. 2 springs back to the rammer, and the chief of breech detail gives the command **RAM**; the chief of breech detail and No. 1 working on the right of the rammer staff and Nos. 2, 4, and 16 working on the left, launch the projectile into the chamber. All then take a firm hold of the staff as far to the rear as possible and the chief of breech detail commands **HOME RAM**, when the projectile is seated with the greatest possible force. Then Nos. 1, 2, and 4 quit the rammer, which is drawn back by the chief of breech detail and No. 16. No. 9, who has steadied the shot tray during the ramming, swings it out of the way as promptly as possible and commands **LOWER**. No. 2 receives a section of powder from a member of the powder detail, inserts it in the chamber, and pushes it as far in as possible. No. 1 receives a powder section from a member of the powder detail and places it in the loading tray behind the section inserted by No. 2; the chief of breech detail and No. 16 ram these sections. The same is done with the third and fourth powder sections. No. 16 dismounts from the loading platform with the rammer, and the breech is closed. The chief of breech detail hooks the lanyard to the eye of the firing leaf while the breech is being closed and passes the other end to No. 4, who has dismounted from the

loading platform. He commands **ELEVATE** as soon as the block has started to rotate. No. 3 serves the vent while the piece is being loaded. The gun pointer directs the traversing so as to follow the target continuously. The range setter supervises the depressing and elevating of the piece and calls "range set" when the piece is laid for range; thereafter he keeps it laid continuously for range. The gun commander notes that the breech is closed, that No. 4 is ready to pull the lanyard, or that the safety switch is closed and that "range set" has been given. Then he commands **READY**. The gun pointer commands **FIRE** or fires by closing his firing key at the command **READY** of the gun commander or as soon thereafter as the piece is pointed.

432. The lanyard should be unhooked after each shot. It will be found convenient to have a hook on the railing at the right side of the loading platform in which the lanyard may be hooked between rounds.

433. Every effort should be made in drill to train men to seat the projectile at the command **RAM**; when this can be done, **HOME RAM** is omitted.

Ammunition service.

434. The personnel and duties of the ammunition section are the same as for the 12-inch gun battery, disappearing carriage.

10-INCH GUN BATTERY, BARBETTE CARRIAGE.

435. The organization at the emplacements is the same as that for the 12-inch gun battery, disappearing carriage.

436. The duties of the members of the gun section (22 enlisted men) are the same as those prescribed for the 12-inch gun (barbette) section, except that—

No. 16 does not mount upon the loading platform, but passes the rammer to and receives it from No. 1.

The projectile is seated with one motion at the command **RAM**.

437. The ammunition section (approximately 22 enlisted men) is smaller than that of 12-inch gun battery by 8 members.

8-INCH GUN BATTERY, BARBETTE CARRIAGE.

438. The organization at the emplacements is the same as that for the 12-inch gun battery, disappearing carriage.

439. The duties of the members of the gun section (18 enlisted men) are similar to those given for the 12-inch gun (barbette) section, except that—

There is no chief of breech detail, and his duties are performed by Nos. 1 and 2 in addition to those prescribed.

The powder sections are inserted and pushed into the chamber by hand.

No. 1 pulls the lanyard at the command **FIRE** from a position on the loading platform to the right and rear of the breech.

Nos. 16, 17, and 18 are omitted.

No. 15 is assigned to the hoist tackle detail.

440. The ammunition section (approximately 22 enlisted men) is the same as that for the 10-inch gun.

6-INCH GUN BATTERY, PEDESTAL MOUNT.

441. The organization at the emplacements is the same as that for a 6-inch gun battery, disappearing carriage.

442. The duties of the officers and chiefs of section are similar to those prescribed for a 6-inch gun battery, disappearing carriage.

443. The emplacements are in charge of an emplacement officer, or officers when there are more than two emplacements, and each gun is manned by a gun section (11 enlisted men), consisting of a gun commander (a noncommissioned officer), a gun pointer (a noncommissioned officer or private), a range setter (a noncommissioned officer or private), and 8 privates.

444. The ammunition section (approximately 7 enlisted men for each emplacement), consists of a chief of ammunition service (a noncommissioned officer), and details for each gun of the battery, each detail to consist of such noncommissioned officers and privates as the installation requires.

445.

6-inch gun (pedestal mount).

Details.	At command POSTS.	At command EXAMINE GUN.
Gun pointer (noncommissioned officer or private).	The gun pointer procures the sight, places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight and examines and tests the traversing mechanism and the firing circuit.
Range setter (noncommissioned officer or private).	The range setter procures a stop watch and an abridged range table. He takes post facing the range scale.	The range setter tests the range transmission apparatus and the elevating mechanism. He cleans and oils the gears.
Breach detail, Nos. 1, 2, 3; No. 1 is chief of detail.	No. 1 procures a wiper or cotton waste and a can containing synovial oil and a sponge. He places the can convenient to the breach and takes post about 2 feet to the rear of the breach, facing it. No. 2 procures a wiper or cotton waste and the loading tray, if one is used, places the tray convenient to the breach, and takes post about 2 feet to the rear and left of the breach, facing it. No. 3 procures the lanyard, the primer pouch, and holder containing punch and drill, and takes post about 2 feet to the right of the breach on line with its face, facing it.	No. 1 removes the breach cover and places it at the designated place. He examines the chamber and bore, cleans and oils the breach block and mechanism. If the chamber or bore need sponging, he calls for the proper sponge and sponges the chamber, assisted by No. 4, or the bore, assisted by Nos. 2, 3, and 4. No. 2 examines the breach recess and gas-check seat, cleans and oils them, and assists in sponging the bore. No. 3 examines the lanyard, firing attachment, and vent. He clears the vent and cleans the primer seat. He assists in sponging the bore.
Rammer detail, No. 4.	No. 4 procures the rammer and takes post about 4 feet in rear of the breach, facing it. He holds the rammer in a vertical position with his right hand, its head on the platform by his right foot.	No. 4 lays aside the rammer, brings up the proper sponge when called for, and assists in sponging.

445.

6-inch gun (pedestal mount).

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
The gun pointer sets the deflection received and follows the target continuously. He fires the piece (or gives the command FIRE) as soon after the command READY as the piece is pointed. He endeavors to locate the position of the splash of his shot and corrects his deflection, if necessary.	No duties.
The range setter calls the deflection to the gun pointer and keeps the piece laid continuously for range, in accordance with the transmitted information. He watches the time-range board and checks the laying of the piece with the information shown thereon.	No duties
No. 1 opens breech, cleans and oils the block when necessary, and as soon as the powder has been inserted closes breech and commands READY. He seizes the lever handle as soon as possible after the piece is fired, and opens breech for the next shot. No. 2 receives the powder charge from No. 7 (or No. 8), inserts it as soon as the rammer is withdrawn, and wipes out the breech recess, if necessary. If a separate loading tray is used, he inserts it as soon as the breech is opened, and withdraws it after inserting the powder charge. No. 3 inserts a primer and lowers the firing leaf of the firing device <i>completely down</i>. He hooks the lanyard and pulls it at the command FIRE. He unhooks the lanyard and removes the fired primer as soon as the breech is opened, and cleans the primer seat.	No. 1 opens breech. No. 2 withdraws the dummy powder charge and passes it to No. 7 (or No. 8). No. 3 removes the primer.
No. 4 rams the projectile home with all possible force as soon as it is launched on the loading tray.	No. 4 brings up the extractor and pulls the dummy projectile back on the loading tray.

445. 6-inch gun (pedestal mount)—Continued.

Details.	At command POSTS.	At command EXAMINE GUN.
Projectile detail, Nos. 5 and 6.	No. 5 procures the wrench for filling plugs, the funnel, and the measure containing hydrolene oil, and takes these to the recoil cylinder. After completing his duties for EXAMINE GUN he replaces his implements and takes post near the serving table, facing the piece. No. 6 procures the chamber sponge and extractor, places them at the designated place, and takes post near the serving table.	No. 5 unscrews the filling plugs and if oil is needed pours it in until it stands in the filling hole, waits a moment to allow the escape of air, and pours in more if necessary. Then he notifies the gun commander that the cylinders are ready for inspection. After the inspection No. 9 screws the plugs well home and replaces his implements. No. 6 removes the muzzle cover and places it at the designated place. He assists the range setter in examining the elevating and retracting mechanisms and cleans and oils the gears.
Powder detail, Nos. 7 and 8.	Nos. 7 and 8 take posts most convenient for the service of powder.	Nos. 7 and 8. No duties.

445.

6-inch gun (pedestal mount)—Continued.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
No. 5 picks up a projectile from the serving table and launches it on the loading tray as soon as the breech is opened. No. 6 arranges the projectiles on the serving table and keeps the table convenient to the breech.	No. 5 removes the dummy projectile from the loading tray and places it on the serving table. No. 6. No duties.
Nos. 7 and 8 alternate in bringing up powder charges and passing them to No. 2.	No. 7 (or No. 8) receives the dummy powder charge from No. 2.

5-INCH GUN BATTERY, 4.7-INCH GUN BATTERY, AND 4-INCH GUN BATTERY.

446. The organization at the emplacements is the same as that for a 6-inch gun battery.

447. The duties of the officers and chiefs of section are similar to those prescribed for a 6-inch gun battery.

448. The service at the emplacements of the 5-inch gun battery, 4.7-inch gun battery, and 4-inch gun battery is similar to that described for the 6-inch gun battery (pedestal mount) or the 3-inch gun battery, depending upon the character of ammunition used; the sections and details are arranged along the lines indicated in the drill of the 6-inch gun or 3-inch gun, as may be most applicable.

3-INCH GUN BATTERY.

449. The organization at the emplacements is the same as that for a 6-inch gun battery.

450. The duties of the officers and chiefs of section are similar to those prescribed for a 6-inch gun battery.

451. The emplacements are in charge of an emplacement officer, or officers when there are more than two emplacements, and each gun is manned by a gun section (6 enlisted men), consisting of a gun commander (a noncommissioned officer), a gun pointer (a noncommissioned officer or private), a range setter (a noncommissioned officer or private), and 3 privates. The ammunition section (approximately 7 enlisted men for each emplacement) consists of a chief of ammunition service (a noncommissioned officer) and details for each gun of the battery, each detail to consist of such noncommissioned officers and privates as the installation requires.

452.

3-inch gun.

Details.	At command POSTS.	At command EXAMINE GUN.
Gun pointer (non-commissioned officer or private).	The gun pointer procures the sight and places it in its seat and takes post in rear of the shoulder piece, facing to the front.	The gun pointer examines the sight and examines and tests the traversing mechanism, the firing circuit, and the lanyard.
Range setter (noncommissioned officer or private).	The range setter takes post near the range scale if the carriage is provided with one; otherwise at the elevating clamp, facing it.	The range setter tests the elevating mechanism and cleans and oils the gears.
Breech detail Nos. 1 and 2.	No. 1 procures a wiper or cotton waste and a can containing synovial oil and a sponge. He places the can convenient to the breech and takes post about 2 feet to the rear and right of the breech, facing it. No. 2 procures a wiper or cotton waste and the sponge; he takes post about 2 feet to the rear and left of the breech, facing it.	No. 1 removes the breech cover and places it at the designated place. He examines the chamber and bore and cleans and oils the breech block and mechanism. If the chamber or bore need sponging he procures the sponge and sponges, assisted by Nos. 2 and 3. No. 2 removes the muzzle cover and places it at the designated place, prepares the lanyard, examines, cleans, and oils the breech recess, assisted by No. 3, and assists in sponging.
Extractor detail No. 3.	No. 3 procures the hand extractor and a pair of gloves. He takes post about 3 feet to the rear of the breech, facing it.	No. 3 removes the filling plug. If the cylinder is not full he procures the measure containing hydrolene oil and the funnel, pours in oil until it stands in the filling hole, replaces the filling plug and the oil measure and funnel. He assists in sponging.

452.

3-inch gun.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
The gun pointer, having taken the travel of the target and set his sight for deflection, follows the target continuously, commands CLAMP (if clamps are provided) and fires or commands FIRE as soon after the command READY as the piece is pointed. If Case I is used he sets the sight for both range and deflection.	No duties.
The range setter keeps the piece laid continuously for range in accordance with the transmitted information, clamps the gun in elevation at the gun pointer's command and unclamps immediately after the gun is fired.	No duties.
No. 1 opens breech, closes it as soon as the cartridge is inserted, and commands READY. If there is difficulty in opening or closing the breech he wipes any residue from the threads of the breech block and oils the mechanism. No. 2 picks up a cartridge and inserts it in the chamber, taking care that the point of the projectile does not strike. If there is difficulty in opening or closing breech he wipes any residue from the threads of the breech recess and oils the threads if they become dry.	No. 1 opens the breech and closes it after the cartridge has been removed. No. 2. No duties.
No. 3 receives the empty cartridge case as it is ejected and lays it aside. He uses the hand extractor when necessary.	No. 3 withdraws the cartridge.

Notes on the drill.

453. All cartridges should be tried in the chamber before using. Those which do not fit accurately must be rejected.

454. If a cartridge jams, attempt must not be made to drive it home by forcing the block; it should be withdrawn and another substituted.

455. If a cartridge case is extracted with difficulty, feel for a burr around the edge of the chamber, and if one is found, file it smooth.

456. With guns on masking parapet mounts, No. 3 procures the ratchet lever at the command **POSTS**, places it on the shaft, and at the command **RAISE GUN** mans the ratchet lever, assisted by the range setter, who clamps the pivot socket. The same numbers lower the gun when the drill is dismissed.

457. The ammunition section keeps the serving table at each gun supplied with ammunition.

6-pounder gun battery.

458. The personnel assigned to 6-pounder batteries is in charge of an officer, who acts as battery commander.

459. There are no range or ammunition sections. Each gun is manned by a gun section (8 enlisted men), consisting of a gun commander (a noncommissioned officer), a gun pointer (a noncommissioned officer or private), and 6 privates.

460. The duties of the battery commander, chiefs of section, and gun pointers are similar to those for the 3-inch gun. The battery commander indicates the target and estimates the range, and the gun pointers set their sights accordingly. Range corrections are made on orders of the battery commander from observation of fire. Deflection corrections are made by the gun pointers as prescribed for larger guns.

461.

6-pounder gun.

Details.	At command POSTS.	At command EXAMINE GUN.
Gun pointer (a noncommissioned officer or private).	The gun pointer procures the sight and places it in its seat and takes post immediately to the right of the trail, facing to the front.	The gun pointer examines the sight.
Breech detail, Nos. 1 and 2.	No. 1 takes post 2 feet to the rear and right of the breech, facing it. No. 2 takes post 2 feet to the rear and left of the breech, facing it.	No. 1 removes the breech cover and places it at the designated place. He examines the chamber and bore and cleans and oils the breechblock and mechanism. If the chamber or bore need sponging he procures the sponge and sponges, assisted by No. 2. No. 2 removes the tomplon and places it at the designated place. He examines the breech recess and gas-check seat, cleans and oils them, and assists in sponging.
Traversing detail, No. 3.	No. 3 procures the wrench for filling plugs, the measure containing hydrolene oil, and the funnel, and takes post immediately to the left of the end of the trail handspike, facing to the front.	No. 3 removes the filling plug. If the cylinder is not full, he procures a funnel and measure of oil, pours in oil until it stands in the filling hole, replaces the filling plug and the oil measure and funnel, and places the trail handspike in its seat.
Clamping detail, No. 4.	No. 4 takes post convenient to the clamps.	No. 4 examines the clamps.
Ammunition detail, Nos. 5 and 6.	No. 5 takes post near the serving table, facing the gun. No. 6 takes post in the magazine or near the ammunition boxes.	Nos. 5 and 6. No duties.

461.

6-pounder gun.

At command LOAD or COMMENCE FIRING .	At command UNLOAD .
The gun pointer directs No. 3 in giving the approximate direction to the gun and No. 4 in clamping and unclamping. He places his right shoulder firmly against the shoulder piece, grasps the handle with the left hand and the top of the shoulder piece with the right and follows the target continuously. He fires as soon after the command READY as the piece is aimed.	No duties.
No. 1 opens breech, closes it as soon as the cartridge is inserted, and commands READY. If there is any difficulty in opening or closing the breech, he wipes any residue from the threads of the breechblock, and oils the mechanism. No. 2 picks up a cartridge from the serving table and inserts it in the chamber, taking care that the point of the projectile does not strike. If there is any difficulty in opening or closing the breech, he wipes any residue from the threads of the breech recess, and oils the threads if they become dry.	No. 1 opens the breech. No. 2 receives the cartridge and passes it to No. 4.
No. 3 grasps the trail handspike with both hands, the right hand near the end, and gives the approximate direction as directed by the gun pointer.	No duties.
No. 4 clamps and unclamps under direction of the gun pointer.	No duties.
No. 5 brings ammunition of the designated kind from the magazine or the boxes of ammunition and places it on the serving table.	No. 5 receives the cartridge from No. 2 and places it on the serving table. No. 6. No duties.

Notes on the drill.

462. To load and fire.—The gun commander repeats the indication of the target and the range and commands: **WITH** (such projectile), **COMMENCE FIRING**.

He repeats the command **CEASE FIRING**.

463. After the first round the projectile is named only when a different kind is ordered, and the gun is loaded without command immediately after it is fired.

464. There is no ammunition section, and the gun commander is in charge of the magazine, except when two or more guns are supplied from the same service magazine, in which case an additional noncommissioned officer is placed in charge of it.

465. During hostilities the ammunition boxes are kept filled with ammunition for use in an emergency.

When this ammunition is used No. 2 takes it from the left box or receives it from No. 1, who takes it from the right box.

466. If a cartridge jams and will not go home with the force due to swinging the breechblock smartly, never attempt to drive it home by forcing the block; withdraw the cartridge and try another.

467. If a cartridge case is extracted with difficulty, feel for a burr around the edge of the chamber, and if one is found file it smooth.

468. If the gun is to be fired in a temporary emplacement, an anchorage should be improvised and made as substantial as possible in order that the recoil may be controlled sufficiently to enable the gun pointer to remain against the shoulder piece, use the short lanyard, and thus secure the maximum rate of aimed fire.

469. Whenever the gun is not anchored securely the long lanyard is used, the spade turned down, and Nos. 1, 2, and 4 step clear of the recoil outside the wheels before the gun is fired.

470. When the telescopic sight is used No. 4 takes the place of the gun pointer at the shoulder piece and the gun pointer operates the clamps, directing No. 4 in elevating and traversing.

471. If No. 3 has difficulty in giving direction by the handspike, the gun pointer directs Nos. 1 and 2 to assist by working on the wheels.

472. Serving tables should be improvised convenient to the piece, or the boxes of ammunition may be placed in a convenient and sheltered place.

473. With the 6-pounder gun having American Ordnance Company drop breechblock mechanism and parapet mount, the organization of the personnel and the drill are the same as in paragraphs 458 to 472, inclusive, with the following modifications:

No. 2 opens and closes breech instead of No. 1.

No. 1 operates the elevating handwheel under the direction of the gun pointer.

Omit all references to the shoulder piece, the long lanyard, the clamps, and the threads of the breechblock and breech recess.

CHAPTER VII.

BATTERY FIRE-CONTROL.

474. The following methods of using the fire-control installation of a battery are based on the type installation, 1909. The general features of the methods are applicable, as a rule, to the standard systems already installed and to the provisional systems:

GUN BATTERY OF THE PRIMARY ARMAMENT.

Manning details.

- 475. Battery commander's station :
 - Battery commander.
 - Battery commander's observers.
 - Telephone operator for F' telephone.
 - Musician.
- 476. Plotting room :
 - Range officer.
 - Plotter.
 - No. 1, assistant plotter.
 - No. 2, arm setter.
 - No. 3, arm setter.
 - No. 4, range-correction computer.
 - No. 5, deflection computer.
 - No. 6, operator for telautograph or alternative means for transmitting information to guns.
 - No. 7, operator for communicating with emergency station.
- 477. Observing stations (for each) :
 - Observer.
 - Reader.
- 478. Emergency station :
 - Observer.
 - Assistant observer.
- 479. Emplacements (for each) :
 - Range keeper (who operates the time-range board).

Indication and identification of a target.

480. The battery commander having identified a target indicated to him from the fire commander's station by description, place in line, or otherwise, it must be indicated to and identified by the observers at B' and B'' and the gun pointers. The battery commander, using the observer's line, commands

TARGET. The observers reply B' and B'', respectively. The battery commander adds a description of the target and at night gives the designation of the searchlight covering it, makes sure that it is correctly identified by the observers, designates the point for observation, and then commands **TRACK**.

481. In addition to a description, the target may have been indicated by the fire commander by the azimuth and range of a predicted point relocated for the B. C. station, in which case the battery commander transmits the azimuth to the guns and the range and azimuth to the plotter; the latter locates the point on the plotting board by means of the gun arm (range correction scale set to normal); the arm setters bring the B' and B'' arms to the point and read and transmit the azimuths to the readers at B' and B'', who set the observing instruments accordingly. The battery commander in the meantime sets his instrument to the predicted azimuth received from the fire commander and describes the target to the observers. The fire commander's observer calls "now," when the target crosses the vertical wire of his instrument; this message is transmitted to the battery commander, who repeats "now" to the observers. Both observers having reported to the battery commander "on target," he designates the point of observation and commands **TRACK**.

482. With the vertical base system targets are indicated and identified by the same commands and means except that the description, azimuth, and range are sent only to the station (B' or B'') at which the D. P. F. is to be used.

483. If, after the command **TRACK**, the battery commander has reason to believe that there is a possibility of confusion of targets on account of the number in the field or other reason, he commands B' (or B'') **DESCRIBE**. The B' (or B'') observer, without ceasing to track, describes the target, giving details in addition to those furnished him by the battery commander in indicating it. When B' (or B'') has confirmed the identification of the target to the satisfaction of the battery commander, the latter repeats back "on target B'" (or B''), and then commands B'' (or B') **DESCRIBE**, until the identification is confirmed.

484. The battery commander may have the gun arm azimuth called to him from the plotting room for checking with his observing instrument.

485. The target is indicated to the guns immediately after it has been identified by the observers. The battery commander sets his azimuth instrument ahead of the target and transmits the reading with a description of the target to the guns. With the sights set to normal the guns are laid at this azimuth. The battery commander or his assistant calls "now" when the target crosses the vertical wire of the B. C. instrument. The gun pointer calls "on target" or "lost." If the gun pointer fails to identify the target at the first trial, the

operation is repeated with more detailed description. Identification may be confirmed in the same manner as for observers.

486. Targets are indicated to and identified by the emergency station in the same manner, the range officer or No. 7 using the speaking tube or megaphone as means of communication for this purpose.

Horizontal base system.

487. The command **TRACK** having been given by the battery commander, each observer follows the target, keeping the vertical wire accurately on the designated point, and stops precisely on the third stroke of the bell. The reader at each station calls out the azimuth. When for any reason the observing interval is not indicated by bell the stop watch is used for the purpose and the commands **READY**, **TAKE** are given by the battery commander's observer over the observer's line. The tracking continues until **CEASE TRACKING**, **VERTICAL BASE** (or other system) is ordered.

488. No. 2 wears a head telephone on line from B'. He sets the primary arm to the azimuth received from B' and calls "set."

489. No. 3 wears a head telephone on line from B''. He sets the secondary arm to the azimuth received from B'' and calls "set."

490. The plotter wears a head set on the line to the guns. He places one side of the targ against the graduated edge of the secondary arm and slides it along the arm until the vertical front edge is exactly at the intersection of the primary and secondary arms; then he brings the gun arm against the targ and calls over the gun line the range indicated on the arm and plots the position of the target. He sends to the guns the deflection called by No. 5 in Case II or the corrected azimuth called by No. 1 in Case III.

491. No. 1, at the first setting of the gun arm, turns the outer scale of the hundredths dial of the gun arm until the zero is opposite the pointer and sets the disk of the degree tally so that the 15 of the scale is opposite the pointer. At every subsequent setting of the gun arm he calls out the reference number corresponding to the angular travel of the target, reading the degrees from the degree tally scale and the hundredths from the outer scale of the hundredths dial. He then resets both scales as prescribed above.

He operates the wind-component indicator and sets the target arm to the azimuth of the gun arm after each setting of the latter.

When Case III is used he calls off the corrected azimuth at every setting of the gun arm except the first two.

492. No. 4 operates the range board and sets the correction slide for the gun arm to the range-board reading.

493. Whenever under extreme conditions the index reading is beyond the limits of the correction scale on the gun arm the following will apply:

For a range-board reading between 2,500 and 3,500, subtract 1,000 from the reading, set the arm accordingly, and add 1,000 yards to the range; for a reading over 3,500, subtract 2,000 and add 2,000 yards to the range; for a reading between 500 and 1,500, add 1,000 and subtract 1,000 yards from the range; for a reading less than 500, add 2,000 and subtract 2,000 from the range. No. 4 calls to the plotter the number of yards the latter must add to or subtract from the range.

494. No. 5 operates the deflection board, calls off the sight deflection in Cases I and II and in Case III applies the resultant correction to the azimuth correction scale of the gun arm whenever it differs from the previous correction by .05 or more.

495. No. 6 transmits to the guns the corrected range announced by the plotter.

496. No. 7 keeps a record of the ranges received from the emergency station and calls these ranges to the plotter when the emergency system is used.

497. The time-interval bells shall be cut off frequently and observations taken from a watch or clock in the plotting room or B. C. station, "ready, take," being called over the line to the observers.

Auxiliary horizontal-base system (B. C. to B', B'', or B''').

498. When the failure of communications or damage to either B' or B'' renders it necessary the battery commander or the range officer may command B' (or B'') **AUXILIARY BASE, TRACK.**

499. The battery commander's observer acts as observer and reader at the B. C. instrument, and the tracking continues with as little delay as possible, the B. C. station becoming the primary and B' (or B'') the secondary station. The gun arm is laid at the azimuth received from the B. C. station, using the diagonal scale azimuth circle; its intersection with the primary (or secondary) arm marks the position of the target.

Vertical-base system.

500. The battery commander orders the vertical-base system and the range officer commands B' (or B'') **VERTICAL BASE, TRACK**, and throws the switches so as to bring both arm setters' telephones in multiple with the reader's telephone in the station ordered. The B'' (or B') arm is laid aside. The observer at B' (or B'') follows the target, stopping the instrument with the horizontal wire on the water line and the vertical wire on the designated part of the target, at the last stroke of the bell. The reader transmits the azimuth and the range to the arm setters. The tracking is continued in this manner until **CEASE TRACKING, HORIZONTAL BASE** (or other system) is ordered. Both arm setters hear azimuth and range. If B' is sending information, No. 2, on hearing the azimuth, sets the primary arm; No. 3 notes the range and

calls it to the plotter as soon as No. 2 calls "set." If B'' is sending information, No. 3 sets the secondary arm and No. 2 calls the range. The plotter places the targ against the arm at the range called by the arm setter, and the remaining operations are as prescribed for the horizontal-base system.

501. Where instruments for both horizontal and vertical base systems are installed practice in the use of each shall be held frequently. Special attention shall be given to practice in changing from one system to the other; a well-drilled range section should make the change without confusion or loss of an observation.

Emergency system.

502. When it is desired to use the emergency system, or when failure of communications or damage to B' or B'' renders it necessary, the battery commander orders emergency system and the range officer commands **EMERGENCY SYSTEM, TRACK**. The assistant observer at the emergency station transmits the ranges to No. 7, who repeats them to the plotter; the battery commander's observer (at B. C.) follows the target with his instrument and calls the azimuth to No. 2, who sets the gun arm, using the diagonal scale azimuth circle and calls "set." The plotting proceeds as prescribed for the vertical-base system except that no duties are required of No 3. In case damage to the B. C. station renders it necessary, the battery commander's observer transfers the azimuth instrument (unless one is already there) to the pier mount in the emergency station, levels and orients it as quickly as possible; he observes and reads the azimuth of the target at each bell. These azimuths are transmitted by the assistant to the plotting room in advance of the ranges read from the emergency instrument.

503. In case of damage to the plotting room, ranges as read from the emergency instrument may be megaphoned or called through the speaking tubes directly to the gun platforms.

504. All targets assigned to the battery should be tracked by the emergency detail. The observer at the emergency range finder sends the range at each observation to the plotting room, where it is recorded by No. 7 for the information of the range officer. When **EMERGENCY SYSTEM** is ordered the ranges are repeated to the plotter.

MORTAR BATTERY.

Manning details.

505. B. C. station:

Battery commander.
Assistant battery commander.
Battery commander's observer.
Telephone operator for the F' telephone.
Azimuth keeper (who operates time-azimuth board).
Musician.

506. Plotting room :
Range officer.
Plotter.
No. 1, assistant plotter.
No. 2, arm setter.
No. 3, arm setter.
No. 4, azimuth computer.
No. 5, operator of device for indicating data to the pits.
507. Observing stations (for each) :
Observer.
Reader.
508. Emergency station :
Observer.
Assistant observer.

Indication and identification of a target.

509. The methods of indication and identification are the same as those prescribed for the fire-control system of a gun battery of the primary armament, except that targets are not indicated to, or identified by, the gun pointers.

Horizontal-base system.

510. The command **TRACK** having been given, the target is plotted by means of the primary and secondary arms from azimuths taken simultaneously from B' and B'' in the same manner as prescribed for a gun battery of the primary armament.

Predicting and firing.

511. The firing interval should not exceed one minute for mortars on carriages, models 1896. The predicting interval is not necessarily equal to the firing interval and is ordinarily taken as one minute. With sufficiently well-trained personnel the firing interval may be reduced to thirty seconds and one-minute predictions made every thirty seconds. In the following description both firing and predicting intervals are assumed to be one minute. For convenience of explanation the observations on which predictions are to be made are designated as "time 1," "time 2," etc. If, for example, the first observation on the target is taken at time 4, the first prediction may be made at time 5 and the salvo or shot fired at time 6. The zone should be indicated before time 5; to do this the plotter, after the last intermediate observation before time 5, estimates the position at which the target will be plotted at time 5 and also the approximate location of the predicted and set-forward points, brings up the mortar arm, calls out the zone, and notes for his own use the time of flight; a well-instructed plotter should be able to make this estimate without material error in the time. As soon as the position of the target is plotted from the observations taken at time 5 the plotter applies the predictor, holding it at an angle of about

45° with the board, the ten-second pointers to the side toward which the target is moving, and marks the predicted and set-forward points. Then he lays the predictor to one side, brings the graduated edge of the mortar arm to the set-forward point, and calls out the elevation. No. 1 reads the azimuth of the set-forward point to No. 4, who sets it on the mortar deflection board and sends the corrected azimuth to the battery or calls it to No. 5, as the equipment of the station requires. Should an arbitrary correction be shown necessary by the observation of the preceding shot or salvo, the battery commander directs **FIRE RIGHT** (or **LEFT**) ——— **HUNDREDTHS**, and No. 4 moves the arbitrary correction pointer to the right (or left) along the deflection scale the distance ordered, this operation preceding the determination of the corrected azimuth of the set-forward point. The plotter next brings the graduated edge of the mortar arm to the predicted point and calls "set;" then No. 1 transmits the azimuth of the predicted point to the battery commander's observer, who sets the battery commander's instrument to this azimuth. The pit being ready, the signal for firing is given when the target crosses the vertical wire of the instrument, providing the time of crossing indicates that no considerable error has been made in prediction. This is a matter for the exercise of judgment by the battery commander or his assistant, but, in general, if the time of crossing varies more than five seconds from the predicted time the command **RELAY** should be given to the pits.

512. Allowance may be made in the time of firing by the officer at the battery commander's instrument for small observed deflection errors, but if these errors are considerable correction should be made on the mortar deflection board.

513. The required data having been transmitted, the plotter notes the travel during the last minute, estimates the position of the next predicted and set-forward points, brings up the mortar arm, reads the zone number, and estimates the time of flight for the next shot or salvo. The tracking is then resumed.

514. If the firing interval is one minute, intermediate observations need not be plotted after the first prediction.

515. If the battery commander's station is also the primary station, the primary arm, instead of the mortar arm, is brought to the predicted point, and No. 2 reads and transmits to the battery commander's observer the azimuth of the predicted point.

516. When the firing interval can be reduced to forty-five or thirty seconds, predictions for one minute ahead may be made every forty-five or thirty seconds.

The auxiliary horizontal-base system—The vertical-base system—The emergency system.

517. The auxiliary horizontal-base system, the vertical-base system, and the emergency system are used under the same conditions and in the same manner as provided for a gun

battery of the primary armament, so far as the location of the track of the target on the plotting board is concerned. Predicting and firing are as prescribed in the preceding paragraph.

BATTERY OF THE INTERMEDIATE ARMAMENT.

518. The methods of using the fire-control system of a battery of the intermediate armament conform to the methods for a battery of either the primary or secondary armament, depending upon the equipment.

BATTERY OF THE SECONDARY ARMAMENT.

Manning details.

519. Range-finding station:

Observer.

Reader (with range finders having outside scales).

Telephone operator.

Operator of device for exhibiting ranges.

Range-finding system.

520. If ranges are not posted at the range-finding station the operator of the device for exhibiting ranges is stationed at a convenient point visible from the gun and ranges are transmitted to him by the reader through a speaking tube, by megaphone or by other means.

521. A target having been indicated by the fire, mine, or battery commander, it is tracked without further orders until **CEASE FIRING** or **CHANGE TARGET** is ordered. The observer follows the target. Ranges, as corrected by observation of fire, are posted at approximately regular intervals, the intervals being as short as is consistent with accurate readings.

522. Wind and drift corrections, obtained from the abridged table, are combined with the travel as determined by the gun pointers, for the first deflection. Thereafter each gun pointer corrects for deflection errors by moving the vertical cross wire in the direction and the approximate amount of the observed error.

523. For rapidity and convenience of identification of targets azimuths to every 5 degrees may be stenciled on the front walls of the emplacements of rapid-fire guns.

524. Range corrections based on observation of fire are made by the battery commander only.

525. Corrections for powder are determined by trial shots. Since batteries of the secondary armament are not provided with range boards, velocity corrections may be applied by shifting the range scale or pointer on the gun carriage; or they may be applied by the operator who sets the device for exhibiting ranges in the same manner as corrections from the observation of fire are applied.

CHAPTER VIII.

BORE SIGHTING, ORIENTATION, AND POINTING.

BORE SIGHTING AND ORIENTATION.

526. Bore sighting.—Guns should be bore sighted frequently in order to check the adjustment of the sight standard and to correct it if necessary. The process is as follows: Place a bore sight in the breech and a thread in the vertical diameter of the muzzle. Sight through the bore sight and bring the muzzle thread on a well-defined point of an object at or beyond the mean range for the piece. If a bore sight is not available the vent or a thread in the vertical diameter of the breech may be used. With the sight in adjustment on the sight bracket and the vertical wire set at normal, adjust the sight standard until the vertical wire of the sight is brought on the point.

527. The azimuth indices of the guns of a battery are set so that when the guns are aimed at a point near the main channel about mid-range from the battery the azimuth reading is the same for each; this to be the correct azimuth from the directing point or gun. In the event of there being two channels of equal importance a point at mid-range and midway between the channels should be taken. By this means the azimuth differences due to gun displacement may be disregarded and in Case III the guns laid at the azimuth of the target from the directing point or gun.

528. In gun batteries of the primary armament range differences are stenciled on the base ring or on the step of the loading platform so that the proper correction for the gun displacement is the number nearest an index marked on the carriage near the elevation scale.

529. The orientation of mortars should be tested frequently and the setting of the azimuth indices corrected if necessary. Two convenient methods are as follows:

First. Having established two intervisible monuments in rear of the pits, and having determined accurately the azimuth of the line joining them, proceed as follows:

Adjust a transit, set it up over a monument from which the pit may be seen, take a reading on the other monument and record it; take a reading on a point in the pit and record it. Move the transit to this point in the pit and backsight on the monument; record the reading.

Stretch strings across the vertical diameters of the breech and muzzle; point the mortar and the transit so that the axis

of the mortar and line of collimation of the transit coincide; record the reading of the transit.

From the readings taken the azimuth of the mortar may be computed and the index set.

The string across the breech may be omitted; in which case the axis of the mortar is fixed by the muzzle string and vent, the mortar being pointed at the transit when this is being done. It must be remembered in calculating the azimuth that the mortar is pointing in the opposite direction from the transit.

Second. By using the B. C. instrument in connection with the transit when they are intervisible, the transit being at any point on the parapet from which it can be sighted into the pit.

Adjust the transit. Set it up so that it can be sighted on the mortar and B. C. instrument; sight on the latter and record the reading. Sight the B. C. instrument on the transit and record the reading. Point the mortar and transit so that the axis of the mortar coincides with the line of collimation of the transit and record the transit reading. From the readings the mortar azimuth may be computed and the index set.

The correct setting of the index should be indicated by a tool mark on the racer.

530. The adjustment of quadrants attached to mortars should be tested frequently and corrected by using a clinometer or a standard quadrant known to be in adjustment.

METHODS OF POINTING.

531. Case I.—This method of pointing is used only with rapid-fire guns where means for laying in elevation by quadrant have not been provided.

Direction and elevation are given by the sight.

The gun pointer adjusts the sight in its seat and sets the elevation and deflection scales for the indicated range and deflection, respectively. He keeps the line of sight as nearly as possible on the designated point of the target and the piece is fired as soon after the command **READY** as it is aimed accurately.

In firing a series of shots he observes the splashes if possible and, when necessary, changes the setting of his sight to correct for the observed deflections. He changes the elevation to correspond to the changing range of the target or on orders from the battery commander.

With two gun pointers, one controls the elevation and the other the direction.

532. Case II.—This is the normal method of pointing all guns. Direction is given by the sight and elevation by an elevation or range scale attached to the carriage. For guns of the primary armament ranges corrected for the time of the next bell are received at the gun every fifteen seconds. The range setter follows continuously in elevation, regulating the speed of the elevating handwheel so that the index indicates

the correct range at the third stroke of the bell. By noting the time-range relation the range setter should be able to perform this operation so that the gun is laid continuously in elevation.

The gun pointer sets his sight to the deflection ordered and traverses or directs the traversing detail so as to keep the vertical wire continuously on the designated part of the target, except for disappearing carriages for a few seconds while the truck is at the breech. If he is on the target he fires or gives the command **FIRE** at the command **READY** of the gun commander; if not, as soon thereafter as the gun is pointed. When possible to observe the fall of his own shot he corrects the deflection by moving the vertical wire the amount and in the direction of the observed error unless otherwise ordered by the battery commander.

533. Case III.—This method of pointing is used exclusively for mortars. Its use for guns is auxiliary and is limited to batteries where the prevalence of fog or other local conditions render it necessary in the opinion of the district commander to prepare to fire at a target obscured from the guns.

Direction is given by the azimuth circle and elevation by the elevation scale or by quadrant.

With guns the range setter proceeds as in Case II.

Corrected azimuths for the next bell are received at the guns every fifteen seconds, and the gun pointer directs the traversing detail so that the gun azimuth is continuously that of the set forward point, except with guns on disappearing carriages for the few seconds the truck is at the breech. Immediately after the withdrawal of the truck the speed of traversing is increased slightly so as to compensate for the delay. By using a stop watch and noting the approximate time-azimuth relation the gun pointer should be able to keep the piece trained continuously in azimuth without material error at the time of firing. The gun pointer commands **FIRE** at the command **READY** of the gun commander or as soon thereafter as he is satisfied that the piece is laid properly. If for any reason the gun pointer can not follow continuously he may set to the azimuth received and fire on the next bell.

POINTING TESTS.

534. At least once each week a pointing test shall be made at gun batteries of the primary armament. In order to simplify the keeping of records, an assumed deflection for wind and drift may be used during the test. This deflection should be changed frequently during the drill so that gun pointers may not know the reading that should be obtained at the end of the time of flight. To accomplish this the platen of the deflection board is set for the assumed deflection, and the setting is not changed so long as the same assumed deflection is used.

A noncommissioned officer uses a stop watch and a time-of-flight table. The gun pointer sets his sight at the de-

deflection received from the plotting room, which is that obtained from the deflection board by combining the correction for angular travel during the time of flight with the assumed deflection for wind and drift. With guns on nondisappearing carriages he directs the traversing so as to follow the target continuously, keeping the vertical wire on the designated point; with guns on disappearing carriages he waits until the truck has been withdrawn from the breech before the piece is traversed. In each case he gives the command **FIRE** as soon after the command **READY** as he is on the target; traversing is stopped and then he follows the target with the vertical wire. The noncommissioned officer with the stop watch starts it at the command **FIRE**; commands **HALT** and stops the watch at the expiration of the time of flight. The gun pointer stops following with the vertical wire at the command **HALT**, when the reading of the deflection scale should be the same as the assumed deflection for wind and drift. If not, the difference is the error in predicting and pointing.

Example.—Assumed deflection, 3.65; deflection sent to gun pointer, 3.20; reading of the deflection scale at end of time of flight, 3.60. $3.65 - 3.60 = 0.05$, the error.

535. The excellence of the gun pointer's work is determined, first, by the accuracy of his pointing; second, by the promptness with which he is able to give the command **FIRE** after the piece is ready.

536. For each trial, records are kept of the time from **LOAD** to **FIRE**, the range to the target, the time from **READY** to **FIRE**, and the deflection error; one copy is forwarded to the post commander and one copy posted on the bulletin board of the company.

537. With disappearing guns it is important that the gun pointer be trained to get on the target in the time necessary to close the breech plus the tripping interval, so that in practice or action he can fire as soon as the gun is in battery. When the gun is not tripped, the command **READY** should not be given until the end of the tripping interval.

538. Once each week the following test shall be made at mortar batteries. The battery commander is assisted by an officer, or noncommissioned officer, equipped with a stop watch and a time-of-flight table. The azimuth of a predicted point and the corresponding time of flight are sent to the battery commander, who sets his instrument to the azimuth of the predicted point, the vertical wire at normal. As the target passes the vertical wire of his instrument, he commands **FIRE**, and follows the target by turning the disk crank. The assistant starts the stop watch at the command **FIRE** and calls "halt" at the expiration of the time of flight. The battery commander ceases tracking and the assistant records the reading of the instrument.

The difference between this reading and the azimuth of the set-forward point as determined from the plotting board is the error in prediction.

Example.—Time of flight, $46\frac{3}{4}$ seconds; azimuth of predicted point, 217.40° ; azimuth of set-forward point, 214.49° ; reading of the azimuth instrument, 214.59° ; error in prediction, 0.10° .

539. Records of this test are made. One copy is forwarded to the post commander and one copy posted on the company bulletin board.

540. Rapid-fire gun batteries shall have frequent drills at pointing and simulating fire at moving objects. Immediately before the simulated firing begins the gun pointer makes a deflection correction for the movement of the target during the time of flight. To do this he sets the index of deflection scale at normal, traverses the gun until the line of sight is a little in front of some point of the target and stops traversing; when the selected point comes on the line of sight he keeps it there during the time of flight by turning the deflection screw. Then he observes the reading of the deflection scale and sets the vertical wire an equal distance on the opposite side of the normal.

The time of flight to the nearest second is given by the gun commander, and the gun pointer measures time by counting.

The gun pointer sets the sight for elevation and follows the target, keeping the gun pointed continuously as far as practicable.

CHAPTER IX.

FIRE AND MINE COMMANDS.

THE FIRE COMMAND.

541. The fire commander is responsible to the battle commander for the tactical efficiency of his fire command.

542. The fire commander is both an administrative and tactical commander. His administrative duties are confined to those affecting the tactical efficiency of his command. In general, he exercises his administrative duties verbally or informally.

General orders to his fire command are issued only from post headquarters.

543. All communications to or from post headquarters affecting his fire command are referred to him for his information and remark. He has no office of record; for information concerning his fire command he consults the records of post headquarters.

His tactical responsibility relates to the condition of the material and to the efficiency of the personnel of his command. He is responsible that the post commander is informed as to any deficiency of equipment or supplies.

On days of battery drill for his fire command he visits the batteries of his command, and on days of indoor instruction he visits the companies assigned to his fire command during the instruction hour.

He requires a thorough knowledge of the installation, equipment, system of fire control, and drill on the part of the officers of his command, and encourages efforts for the improvement thereof.

He should familiarize himself with any modifications or changes requested or made by battery commanders, and whenever he is satisfied from an observation of their use in daily drill that they give reasonable promise of increased efficiency he should recommend their use in target practice and indorse on the report of the battery commander his opinion of the advantages or disadvantages in the changes or modifications proposed.

He exercises supervision of battery target practice as prescribed in orders.

At night drill or action he controls the particular searchlights assigned as illuminating lights for his fire area, and is responsible to the battle commander for their efficient use.

In battle command drill or in action he takes up promptly the attack of the targets assigned to him by the battle commander.

When ordered by the battle commander to assume the exercise of independent fire action, or whenever for any reason the battle commander's station is not manned, he fights the batteries of his command in accordance with his own judgment. He orders "**BATTERY COMMANDER'S ACTION**" whenever, in his opinion, the progress of the attack renders such action advisable, provided "**FIRE COMMANDER'S ACTION**" has been ordered previously by the battle commander, or provided emergency renders it necessary.

544. In exercising fire-control the fire commander determines the order of fire unless this has been prescribed by the battle commander.

545. To order unrestricted fire, the fire commander assigns certain targets to certain batteries and commands **COMMENCE FIRING**.

To order restricted fire, he may give any of the following commands:

BATTERY ———, FIRE WHEN IN RANGE (or AT ——— YARDS). This requires the battery to commence firing as soon as the assigned target is in range, or at the indicated range.

BATTERY ———, FIRE ONE SHOT; COMMENCE FIRING. This restricts the fire to a single shot from one gun.

BATTERY ———, FIRE ONE (or more) ROUNDS; COMMENCE FIRING. This restricts the fire to a certain number of rounds, consisting of one shot from each gun of the battery.

BATTERY ———, FIRE AT ——— INTERVAL; COMMENCE FIRING. This command fixes the rate of fire.

BATTERY ———, FIRE ON SALVO POINT NO. ———. This directs the battery commander to fire a salvo at each vessel as it passes the designated salvo point.

BATTERY ———, BATTERY COMMANDER'S ACTION. This places the action of a battery entirely in the hands of its commander.

Additional commands which may be given are as follows:

FIRE AT SHIPS IN ORDER IN COLUMN; COMMENCE FIRING. This requires that the vessels be fired upon in order in column beginning with the leading ship, continuing the fire until the ship is out of action, and then changing to the next, or until the command **CHANGE TARGET** is given. **FIRE AT SHIPS IN ORDER IN LINE FROM RIGHT (or LEFT); COMMENCE FIRING,** is the corresponding command when the ships are in line.

PREPARE FOR ACTION. This requires that the guns be prepared for loading and the battery held ready for action.

CEASE FIRING. This requires that the battery stop firing instantly.

CHANGE TARGET. This requires that the battery change target according to instructions.

TARGET OUT OF ACTION. This indicates that a certain vessel is considered out of action, and that it is no longer to be fired upon.

At night the target may be indicated by the command, **TARGET IN NO. ———**. For example: **BATTERY DE RUSSY, TARGET IN NO. 1, FIRE TWO ROUNDS, COMMENCE FIRING.** This requires that Battery De Russey fire two rounds at the target illuminated by Searchlight No. 1.

At the conclusion of drill practice or action, the fire commander commands **CLOSE STATION**.

546. The fire commander should have the assistance of a communication officer, who has charge of the system of communications and the fire commander's manning party. In case an officer is not available, a noncommissioned officer may be assigned to this duty.

547. To prepare for drill or action the communication officer inspects the equipment of the station, verifies the adjustment of the position-finding instrument, receives the reports of the chiefs of detail, and reports to the fire commander: "Sir, fire-command stations in order," or reports defects he is unable to remedy without delay. His special duty is to transmit the orders of the fire commander to the battery commanders.

548. Each member of the manning party on reaching his station examines the instrument to which he is assigned, makes the prescribed tests and adjustments, and reports to his chief of detail. On completion of the examination each chief of detail at the primary and secondary stations reports to the communication officer: "Sir, F' (or F'') in order," or reports defects he is unable to remedy without delay.

549. The senior chief of detail at each station is in charge of the station. When the command **CLOSE STATION** is received he sees that the instruments are secured and covered, that the switches controlling the electric circuits are left open, and that the windows are closed and fastened securely.

The duties of the members of the details are similar to those prescribed for the corresponding members of the fire-control section of a gun battery.

550. On days of battery drill the details are instructed in use of their equipment and exercised in vessel tracking.

FIRE-CONTROL SYSTEM OF A FIRE COMMAND.

Manning parties.

551. Primary station:

Fire commander.
Communication officer.
Electrician-sergeant.
Observer.

551. Primary station—Continued.

Reader.

Operator for the searchlight controller.

Operator for each telephone.

Plotter and assistant plotter, and two arm setters, when plotting board is used.

Orderly.

552. Secondary station:

Observer.

Reader.

Indication of a target.

553. The fire commander indicates the target to the observer at F'' in the manner prescribed in paragraphs 480 to 483, inclusive.

554. A target is indicated to a battery commander by its description and general location. In addition, it may be tracked for two or three observations and its predicted position for a convenient interval ahead located. This predicted position is relocated for the battery by means of the pantograph attachment of the F' plotting board, when provided, and the relocated range and azimuth sent to the battery commander's station. The fire commander's instrument is set to the predicted azimuth and "now" called over the telephone as the target crosses the vertical wire.

555. If it be desired to concentrate the fire of two or more batteries on the same target and but one fire command is in action, the fire commander having put one battery on as prescribed above may command **BATTERY ——— (or BATTERIES ——— and ———) TARGET UNDER FIRE, COMMENCE FIRING.** This method should not be followed if more than one fire command is in action, since a battery commander might mistake the target.

THE MINE COMMAND.

556. The mine commander is in direct command of the elements of the mine defense during drill and action. His station is at the mine primary, which is connected by telephone to the battle commander's station. He bears the same relation to the battle commander as do the fire commanders and his duties are similar to theirs.

557. The mine commander is responsible that the property officer requests for all material and apparatus necessary to carry out the approved scheme for mining the harbor; he is responsible, further, that the property officer keeps this material and apparatus in proper condition for immediate service.

558. The senior company officer of the mine command is the property officer and obtains from the artillery engineer all necessary material and apparatus for the mine defense. He has direct charge of the storeroom, cable tanks, loading room,

wharves, boats, boathouses, and mining casemate. All personnel of the mine command are subject to his orders for service in connection with caring for or operating any of this material.

FIRE-CONTROL SYSTEM OF A MINE COMMAND.

Manning parties.

559. Primary station :

Mine commander.
Assistant mine commander.
Observer.
Reader.
Searchlight operator.
Operator for each telephone.
Plotter and two arm setters.
Orderly.

560. Double primary station :

Double the above except mine commander and orderly.

561. Secondary station :

Observer.
Reader.

562. Double secondary station :

Double the above.

563. Casemate :

Two casemate electricians.
Operator for each telephone.

564. The methods of operating the fire-control system are similar to those used for gun fire-control. Such slight modifications as are necessary will suggest themselves in service.

CHAPTER X.

THE BATTLE COMMAND.

565. The battle commander is a tactical commander only.

566. Responsibility for the sufficiency and condition of the material of the battle command devolves upon the commanding officers of the districts and posts in which it is located.

567. The battle commander is responsible to the district commander for the tactical efficiency of the command in battle command exercise, at drill, at practice, or in action.

He commands the fire action from his station, from which the whole battle area and the approaches thereto should be visible.

He must have a full knowledge of the nature and position of the mines and obstructions in his battle area.

He is in communication with each fire and mine command of his battle command and with the headquarters of the district commander.

He is informed by the district commander of the defensive dispositions made to protect the flanks and rear of his command in case of an attack by a landing party, and his duties in connection therewith.

By a careful study of his battle area and consideration of the location and strength of his fire and mine commands he prepares plans of defense to be used against the forms of attack liable to be adopted by an enemy. While it is not practicable to anticipate all the conditions that will arise during an engagement nor all methods of attack that might be adopted by an enemy of initiative and resource, there are certain forms of attack which may be anticipated and for which a single command from the battle commander will be sufficient to start all or part of the units of his command to defeat the object of the enemy, leaving the battle commander free to observe the progress of the engagement and determine at comparative leisure how best to inflict the greatest injury upon the enemy while preventing the object of the attack. For example, if the attack is a reconnaissance in force to determine the strength and location of the batteries of the defense, the batteries to be used by the defense, and those to be masked having been decided upon in advance, a single command, as **FIRST GENERAL DEFENSE PLAN** sent to the fire commanders and by them transmitted to the battery commanders, will be sufficient to start the designated batteries firing and notify the battery commanders of other batteries that they are to hold their fire in reserve until special orders to the contrary are given.

Should the attack take the form of an attempt to run by, the following plan of defense might be adopted: All guns and mortars to be concentrated on the leading vessel until **CHANGE** is given, when all gun batteries change to the second vessel and the mortars to the last vessel in the attacking column; since, if the first vessel has been put out of action by the concentrated fire of the battle command, it will be reasonable to suppose that the gun fire alone will be sufficient to complete the confusion at the head of the column and efforts to disable and confuse the rear should be made with a view to preventing the retreat of the enemy. A single command, as **SECOND GENERAL DEFENSE PLAN**, would be sufficient to put this plan of defense in operation.

568. Only the most general directions can be laid down, and each battle commander must decide upon and prepare the plans best suited to his battle area.

569. Each battle command drill should open by drill at one of the defense plans in order that all units of the command may be thoroughly conversant with their duties. The latter portion of the drill should be devoted to the assignment of special targets to fire commands to simulate an action to which no general defense plan applies.

570. A communication officer has charge of the battle commander's station. To prepare for drill or action, he inspects the equipment, except that pertaining to the searchlight system, verifies the adjustment of the position finder, receives the reports of the chiefs of detail, and reports to the battle commander, "Sir, station in order," or reports defects that he is unable to remedy without delay. He has charge of the communications to the fire and mine commanders' stations during drill, practice, or action, transmits orders of the battle commander to and receives communications from such stations.

571. The searchlight officer has charge of the searchlight service and of the manning party assigned thereto during drill, practice, or action. His station is at the battle commander's station or within speaking distance of the battle commander. He is responsible to the battle commander for the tactical efficiency of the searchlight service and for prompt reports of defects in equipment to the artillery engineer.

572. Lights intended primarily for the mine service remain ordinarily under the control of the mine commander, but when the battle commander deems it necessary to use a mine-field light for searching, such light is under control of the searchlight officer temporarily.

573. Prior to drill or action the searchlight officer inspects his equipment, receives the reports of his assistants, and reports to the battle commander, "Sir, searchlight system in order," or reports defects that he is unable to remedy without delay. His special duty is to maintain a thorough watch and search of the battle area.

574. Each member of the battle commander's details on reaching his station examines the instrument to which he is

assigned, makes the prescribed tests and adjustments, and reports to the communication officer, "Sir, ——— in order," or reports defects he is unable to remedy without delay.

FIRE-CONTROL SYSTEM OF A BATTLE COMMAND.

Manning party.

575. Battle commander.

Communication officer.

Searchlight officer.

Master electrician.

Observer.

Reader.

Operator for each telephone.

Operator for each searchlight controller.

Orderlies.

Indication of a target.

576. During the day the battle commander need indicate the target in a general way only, no attempt being made to give the exact location of the ship or ships by range and azimuth.

If two or more squadrons enter the battle area, a particular one may be indicated to the fire commander by its relative position.

When the squadrons are in different well-known channels they may be indicated as the squadron or vessels in ——— channel.

When the attacking ships are in well-defined column they may be indicated by their position in the column.

577. Targets may be indicated at night by means of the searchlights, a battle commander indicating a target to the fire commander by covering it with a searchlight. The battle commander may cause a target to be illuminated and followed by some light, and direct any particular fire commander or all of the fire commanders to open fire on such a target.

578. To order unrestricted fire, the battle commander assigns targets to fire commanders and commands **COMMENCE FIRING**.

To order restricted fire, he uses commands similar to those prescribed for fire commanders, substituting the name of the fire command for that of the battery, or transmits instructions to the individual batteries of his command through the fire commanders, using the commands prescribed in paragraph 545.

579. To place the action of a fire command entirely in the hands of its commander, the battle commander designates the fire command and commands **FIRE COMMANDER'S ACTION**. If a particular squadron is also designated, the action will be limited to that squadron.

CHAPTER XI.

THE ARTILLERY DISTRICT.

580. Districts are established, their limits defined, headquarters designated, and commanders assigned in orders from the War Department.

581. The personnel of artillery district headquarters consists of the district commander, the adjutant, the quartermaster, the ordnance officer, the artillery engineer, and the enlisted force.

582. With the sanction of the department commander the commanding officer of an artillery district may continue to exercise the more important functions of his command when absent temporarily from his district on artillery duty within the department.

583. The district commander is both a tactical and an administrative officer. Unless also a battle commander, he exercises tactical functions in a supervisory way only.

584. The district commander requires of his officers a thorough knowledge of the installation, equipment, system of fire control and drill for battle, fire, mine and battery commands and also encourages a study of them with a view to improvement therein. Whenever in his opinion a proposed change gives reasonable promise of increased efficiency he should authorize a test of it at the next regular target practice.

585. The district commander makes inspections of his district at periods prescribed in War Department orders. He has control within the district of all matters relating to instruction, drill and target practice. He prescribes the hours of drill and instruction for the district.

586. Subject to control by the department commander, the operation of all means of water transportation assigned by competent authority for the exclusive use of the artillery district, including harbor vessels, tugs, lighters, dispatch boats, and launches, are under the supervision of the artillery district commander, whose duty it is to see that economy is exercised in their maintenance and operation. He combines the operations of these vessels so as to limit them to the lowest number that can perform the service satisfactorily, bearing in mind that, when needed for artillery drill, vessels ordinarily engaged in the transportation of troops and supplies, or in other duty, should be withdrawn temporarily to provide an efficient drill service.

587. The district commander shall attend all service target practice and exercise general supervision.

588. The district commander conducts combined artillery drill and tactical exercises of all the elements of defense of his district during the annual encampment and at such other times as he may deem necessary.

During hostilities he is charged with the supervision of all military operations in his district, and in connection therewith establishes and maintains a system of security and information on both land and water fronts and keeps the various subordinate commanders informed as to conditions.

589. The district commander regulates the boat service so that a target may be towed one day each week for each post.

When a target is towed the same rules are observed with respect to signals during drill as govern during practice, and the same care should be exercised in applying them.

590. The district commander designates at least one night each week for night drill, and prior to each drill prescribes its character.

591. The district artillery engineer is charged with the accountability for all engineer and signal property, stores, and installations that have been turned over to the Coast Artillery, and all mine property, stores, and installations in the artillery district. He inspects all such property, stores, and installations at each post in his district at least once each calendar month.

He makes timely requisitions for each post separately for engineer, signal, and mine stores and for all necessary equipment required for the approved installations in the artillery district, and is responsible, under the artillery district commander, for their sufficiency.

He issues engineer and signal property and stores to the artillery engineers at posts and mine property and stores to the commanding officers of companies and detachments assigned to the mine defense.

He recommends the transfer, when necessary, of available engineer, signal, and mine property from one post to another within his district to the artillery district commander, who is authorized to make such transfer unless the efficient operation of any approved installation or scheme of defense will be impaired thereby. No apparatus or plant installed in any fortification, nor any article or material belonging to such plant, the efficient operation of which will be impaired thereby, shall be transferred without the approval of the Chief of Coast Artillery and the chief of the supply department concerned.

592. No increase of load upon any fortification electric plant beyond that contemplated at the time of installation, or transfer of the same or any essential part of it, or any change in the electrical connections thereof, shall be made without the approval of the Chief of Coast Artillery and the chief of the supply department concerned.

593. The district artillery engineer has general supervision over all authorized repairs to the property for which he is accountable.

594. Minor repairs that can be made with the facilities at his disposal are made under the supervision of the post artillery engineer; those which can not be so made are reported by him to the post commander and to the district artillery engineer. The necessity for all repairs that can not be made with the facilities available in an artillery district are reported by the district artillery engineer, through the artillery district commander, to the representative of the proper supply department charged with the installation, supply, and repair in that locality. If repairs to power plants, reported as necessary, can not be made with the facilities at the command of the post artillery engineer, but can be made with the aid of the resident ordnance machinist and by the use of material from the artillery district ordnance repair shop, the district artillery engineer requests the artillery district ordnance officer to make such repairs, which the latter is authorized to do, provided that the work on the armament be not interfered with. In accordance with the regulations of the respective departments concerned, reports of such repairs shall be made as follows:

(a) Report by the representative of the department performing the actual work.

(b) Report by the representative of the department eventually chargeable with the cost of the work.

595. Whenever working parties are sent into an artillery district for the purpose of making repairs the officer or other person in charge shall notify the artillery district commander. Before such parties are sent into an artillery district, the artillery district commander shall be consulted with a view to selecting a time that will interfere as little as possible with drill and target practice, having due regard for the efficient and economical execution of the work.

596. The district artillery engineer, or a suitably qualified officer selected by the artillery district commander, tests in accordance with orders from the War Department the mine cable stored in the district, recording the same in the cable book supplied from the torpedo depot.

597. The artillery district ordnance officer is charged with the accountability for all ordnance property and ordnance stores pertaining to the modern seacoast armament and equipment in the artillery district that have been turned over to the artillery, and inspects all such property and stores in the artillery district at least once each month.

He makes timely requisition for ordnance stores and supplies for each post separately, and is responsible, under the artillery district commander, for their sufficiency.

He issues to post ordnance officers on memorandum receipts all ordnance property and supplies pertaining to the armament at their posts. He recommends the transfer of avail-

able ordnance property and stores from one post to another within the artillery district to the artillery district commander who is authorized to make such transfers, but the transfer of guns, carriages, and range finders, or other material permanently emplaced, shall not be made without authority from the Secretary of War.

He has charge of all ordnance repair shops installed in the artillery district, supervision over resident and other machinists of the Ordnance Department in the absence of the district armament officer, and general supervision over all authorized repairs to the property for which he is accountable.

CHAPTER XII.

THE POST.

598. The senior line officer for duty at a post is post commander. As post commander he exercises administrative control only.

599. Post commanders detail officers at their posts to perform duties corresponding to those of the artillery district staff officers.

As tactical commander he may be battery commander, fire or mine commander, battle or district commander, depending on the armament of his post and the organization of the district in which it is located. As an administrative commander, certain of his duties involve tactical responsibility.

He is responsible that duties connected with the care of the armament are given precedence without exception over all other post duties.

He is responsible for the sufficiency of the material and the efficiency of the personnel at his post.

He is responsible that the artillery personnel attend the artillery drills and exercises prescribed in orders.

He is responsible for the proper execution of all orders affecting artillery instruction and drills, and that the regulations affecting target practice are adhered to.

600. Details for fire-control stations, except those for battery and mine fire-control stations, are made from post headquarters.

601. An officer at each post is detailed as artillery engineer; when the post is district headquarters the district artillery engineer is post artillery engineer.

602. The artillery engineer has charge of the maintenance of communications for fire-control, the operation of power and light plants for artillery and post purposes, and the care and maintenance of searchlights and their controlling mechanisms. He has charge of artillery instruction in visual signaling, of the service of signal stations, and of the maintenance of post telephone and telegraph lines.

He issues the stores necessary for the maintenance and preservation of the property with which he is charged, and makes such authorized repairs as the facilities at hand will permit. He reports through the post commander to the district artillery engineer the repairs which he is not able to make.

603. The artillery engineer prepares statements of the articles supplied by the Engineer Department and Signal

Corps required for the use, repair, and care of the power and communication installations in his charge, and submits the same, through the post commander, to the district artillery engineer for his information in preparing estimates and requisitions.

604. Unless required to command a tactical unit, the artillery engineer shall not be assigned as a member of any manning party, but shall be present for all drills and go wherever his services are needed in maintaining the service for which he is responsible.

605. The artillery engineer is responsible for all fire-control stations and power plants out of commission. Once each week the post commander should supply him with the necessary details so that he may test the condition of the installed communication apparatus out of commission. Any defects discovered must be remedied at once.

606. It is prescribed in orders that the fire-control installation shall be tested at least once each year under the direction of the department commander. The artillery engineer shall be present at this test. Such portion of the equipment as is stored under paragraph 889 shall be installed and tested. If at any time the maintenance test required by Signal Corps Manual No. 8, p. 344, indicates the existence of a serious defect in a line, complete test shall be made at once by the artillery engineer and if there is material deterioration, report forwarded to the Adjutant-General for the information of the Chief of Coast Artillery.

607. The artillery engineer keeps records of all breakdowns and failures of apparatus, and on December 31 of each year forwards a condensed report to The Adjutant-General of the Army for the information of the Chief of Coast Artillery.

608. Although the power plants of seacoast batteries, including reserve plants, are under direct control and charge of the artillery engineer, battery commanders have access to those pertaining to their batteries and in case of emergency exercise such control as they deem necessary, reporting the facts to the post commander when such emergency has arisen.

609. While battery commanders are responsible for the care of the apparatus entrusted to them, the artillery engineer is responsible for its maintenance. The battery commander remedies minor defects only. Repairs are made by the artillery engineer.

610. The artillery engineer is entirely responsible for the meteorological station, the tide station, the searchlight stations, the wireless and such other signal stations as may be established.

611. The artillery engineer is assisted by such master electricians, engineers, electrician-sergeants first and second class, master gunners, and firemen, as may be assigned for duty at the post, and such additional enlisted men as may be necessary to enable him to keep all installed machinery, storage bat-

teries, cable, pole lines, and other electrical and power apparatus in serviceable condition and to operate the same.

612. Master electricians are members of battle command manning parties. During drill they go wherever their services are needed. Under the direction of the artillery engineer they have general supervision of the electrical and power installations of an artillery district. They assist the artillery engineer in his work, and are required to make inspections and tests of electrical plants and installations, and perform such other technical duties as may be necessary in the districts to which they are assigned. When there is only one master electrician in an artillery district he should not be assigned to specific duties at one post to the exclusion of other posts. Their other duties are defined in War Department orders.

613. Electrician-sergeants are members of fire and mine command manning parties. During drill they are under orders of their respective fire and mine commanders for maintaining fire-control apparatus. They are responsible primarily for the maintenance of the communications of the fire and mine commands and make tests and repairs under direction of the artillery engineer so that the fire-control apparatus will be ready for service at all times. Their other duties are defined in War Department orders.

614. Engineers supervise, care for, and operate the power plants, machine and repair shops, and such mechanical and electrical apparatus used for power purposes as may be placed under their charge. Engineers may be required to perform such other technical duties as may be necessary in the district or at the post to which they are assigned.

615. Firemen are assigned to power plants. They perform such duties as pertain to the care and operation of boilers and accessories, including the police of the boiler and engine room. They may be required to assist the engineer in his work.

616. Master gunners are employed in photographic work and seacoast engineering, in the preparation of tables, charts, and maps, and for such other technical artillery duties as they may be qualified to perform.

Meteorological station.

617. The station is in charge of a meteorological observer, who is responsible for the station, the property therein, and the care, preservation, and adjustment of the instruments. He must be present in his station whenever the armament is served. As soon as he arrives at his station he adjusts the mercurial barometer and tests the aneroid, noting any correction to be made. Then he connects the electrical device (if one is provided) of the anemometer, adjusts the stop-watch device if necessary, and notes whether the wind vane works freely. He reports to the battle commander's station, "Meteorological station in order," or reports defects he is unable to remedy without delay.

He reads the barometer and thermometer and by means of the atmosphere board determines the atmosphere reference number. He reads the azimuth of the wind and determines its velocity by means of ten readings of the anemometer. Then he reports to all fire commanders' stations the barometer and thermometer reading, as well as the atmosphere reference number and the velocity and azimuth of the wind.

618. The velocity and azimuth of the wind should be recorded at least every twenty minutes, and oftener if necessary; any sudden change, either in direction or velocity, of any considerable magnitude is reported at once to the fire commanders. When the atmosphere reference number changes by more than 1 per cent, the barometer and thermometer readings and the new atmosphere reference number are reported to the fire commanders.

619. The meteorological observer keeps a complete record of all meteorological messages.

Tide station.

620. The station is in charge of a tide observer. He must be present in his station whenever the armament is seived. He is responsible for the station and the instruments therein. On arriving at his station he reports to the battle commander's station, "Tide station in order," or reports defects he is unable to remedy without delay, and telephones the state of the tide to the fire commanders. Thereafter he reports the tide for every change of one-half foot.

CHAPTER XIII.

ARTILLERY INSPECTION.

621. The armament is manned, instruments adjusted, and everything prepared for service.

622. The inspector visits the stations and emplacements in such order as may be most convenient. During the inspection of a command he is accompanied by its commander.

623. As the inspector approaches a fire-control or other station the officer or noncommissioned officer in charge commands **ATTENTION** and salutes. The equipment is inspected and operated as may be necessary to determine its working condition and the efficiency of the personnel.

624. As the inspector approaches a battery he is met and saluted by the battery commander, who accompanies him during the inspection of the battery.

625. When the inspector approaches a gun emplacement the gun commander commands **ATTENTION, OPEN BREECH**, and gives such other commands as may be necessary for the execution of the inspector's instructions.

626. As the inspector enters the pit of a mortar battery the pit commander commands **ATTENTION, PREPARE FOR INSPECTION**, and as he approaches each piece the gun pointer commands **OPEN BREECH** and such other commands as may be necessary for the execution of the inspector's instructions.

627. At the conclusion of the inspection the battery commander executes such drills as the inspector may order.

628. An artillery inspection should be conducted so as to include the following:

(a) An examination of the equipments, the implements and all parts of the guns, carriages, and emplacements, special attention being given to:

Obturator, to see if they are adjusted properly and pads in serviceable condition.

Elevating and traversing mechanisms.

Devices for running in and from battery.

Recoil cylinders.

Throttling valves.

Oil holes and grease cups.

Adjustment of sights and means of giving quadrant elevation.

Adjustment of subscales of azimuth circles.

Firing attachments.

Firing batteries and circuits.

Motors and controllers.

Sponges.

Rammers.

Condition of doors.

Condition of drains and diagrams of same posted.

Condition of hoists.

Condition of electric and other lights.

Condition of electric installation and power plants.

Condition of galleries and magazines.

Condition of emplacements and grounds in their vicinity.

(NOTE.—All doors should be opened and closed. In preparing guns, mortars, and their carriages for inspection the oil need not be removed from bearing surfaces.)

(b) Examination of fire-control stations and apparatus, special attention being given to condition and adjustment of all instruments and appliances, tables, and charts.

(NOTE.—Power plants, lights in magazines, and range transmission apparatus on loading platforms and on carriages should be in operation during the inspection.

At batteries in service the companies should be exercised in serving the guns and mortars with dummy ammunition, in tripping the guns, and in simulating fire at a moving target, including all details of fire control. In testing the service of the piece at inspection the time for service of ammunition begins with the projectile on delivery tables at mortar batteries, on the receiving table at gun batteries with hoists, and on skids at the door of the ammunition room for gun batteries without hoists; it ends with the projectile on the truck in the loading position. The time for simulating firing one shot from each gun or one salvo from a mortar pit begins at the command **LOAD**, with the ammunition in the loading position, the breechblock closed, and, with mortars, pieces clamped at an elevation of 45° or more.)

(c) Examination of mining casemate, storeroom, loading room, wharves, boathouses, cable tanks, and mine-planting boats, special attention being given to:

Operating boards.

Engines.

Motors and generators.

Storage batteries.

Sleeping rooms.

General condition of buildings.

Painting of the mine cases.

Piling of the mine cases.

Lubrication of screw threads on all apparatus.

Condition of anchors, distribution boxes, mooring ropes, and raising ropes.

Condition of small tools and supplies.

Condition of cranes, tram cars, and trucks.

Storage of the cable and security of all ends above the water.

And for boats:

General condition.

Condition of engines.

Condition of hoisting apparatus.

Condition of davits and blocks.

Condition of cable-laying apparatus.

Condition of small tools.

Condition of men's quarters.

CHAPTER XIV.

TARGET PRACTICE—SALUTES.

629. Special regulations governing target practice are published in orders and artillery memoranda from the War Department.

630. Coast-artillery target practice is divided into sub-caliber practice and service practice.

SUBCALIBER PRACTICE.

631. The object of subcaliber practice is to develop fire efficiency.

632. Subcaliber practice at gun and mortar batteries consists of—

Battery practice:

(a) Preliminary at fixed targets.

(b) Record, normal conditions, at moving targets.

(c) Record, emergency conditions, at moving targets.

Fire or mine command practice at moving targets.

Battle command practice at moving targets.

633. Preliminary practice is for the purpose of adjusting the subcaliber guns and determining the muzzle velocity, and for preparing or verifying subcaliber range scales of rapid-fire guns.

634. The emergency practice is for the purpose of simulating battery commander's action when the regular fire-control installation is out of action.

635. The battery commander conducts battery practice; the fire commander, fire-command practice; and the battle commander, battle-command practice.

636. The officer conducting the practice is responsible for the safety of the field of fire.

637. The district commander determines when the practice shall be by battery and when by fire or battle command. On account of the effect of the wind on the target and on the light projectile, subcaliber practice shall be held, so far as practicable, on clear, calm days.

638. In subcaliber practice the methods of fire control prescribed for drill and service practice are employed unless a departure from the prescribed method has been authorized to test devices or systems of drill with a view to improvement.

639. In order to simulate the conditions of service practice the gun pointer of a gun on a disappearing carriage should not be permitted to follow the target continuously during subcaliber practice. He should be required to cease traversing

from the time the breech block is opened until the charge is inserted, this being the time when, in actual loading, the truck is at the breech. After the charge has been inserted he should endeavor to get on the target in the time necessary to close the breech, plus the tripping interval. The command **TRIP** is given for each shot, and at this command the gun commander starts a stop watch; he calls **READY** at the end of the tripping interval. The gun pointer is not permitted to give the command **FIRE** before **READY** is called.

640. When possible, subcaliber ammunition shall be expended at the batteries to which the companies are regularly assigned.

641. Whenever the conditions of safety permit a company having service practice away from its home station shall have subcaliber practice at its home station.

SERVICE PRACTICE.

642. Service practice is divided into—

Battery practice.

Fire-command practice.

Battle-command practice.

643. Service practice is held at such times as may be designated by district commanders in accordance with orders from the War Department.

644. The district commander shall be present in all cases and exercise general supervision.

645. At posts where no field officer is stationed the district commander exercises the functions of fire commander and details staff officers accompanying him to assist in the duties to be performed by officers not belonging to the company firing.

646. When a company commander is a fire or mine commander a senior officer shall be detailed to act as fire or mine commander during service target practice of his company.

Precautions for safety.

647. Service practice shall be preceded by careful instruction and shall not be held by a company of coast artillery until such company is thoroughly familiar with all of the equipment supplied for the service of the battery at which the company is to fire.

648. No man shall be detailed to a position at the practice for which he has not been instructed at a reasonable number of drills immediately preceding the practice.

649. During target practice no flag or signal shall be displayed at any battery on shore, except at the firing point or at some other point at which the range observing party on the tug has had previous notice.

650. In case of a misfire in artillery practice the primer, if it did not explode, may be removed after a delay of a few seconds and a new one inserted; in case it did explode the old primer should not be removed and a new one inserted

within five minutes; when the primer explodes and the piece misses fire the breech shall not be opened for at least ten minutes. If there is doubt as to the explosion of the primer, explosion shall be presumed.

651. If firing by electricity, the circuit should be broken before the primer is removed. When using fixed ammunition and percussion primers, a second trial of the primer should be made if the firing device can be cocked by hand without opening the breech, but if this also fails the breech must not be opened and a new cartridge substituted within ten minutes. If it is found necessary to open the breech when using obturating primers the vent should be examined and cleared if necessary and the rear section of the powder charge pulled a little to the rear (except in mortars) so that the mushroom head will push it to its place, the breech closed, and another primer tried.

652. The accumulation of black powder residue in the chamber is liable to occur when firing blank charges or service charges of black powder, and may occur due to the priming charge when smokeless powder is used. Care must be taken to prevent this accumulation. Therefore it is prescribed that the chamber shall be sponged with a damp sponge after each shot when firing blank charges or black powder charges and that, in service practice, using smokeless powder, the firing shall be suspended after each ten shots for the time necessary to clean the chamber with a damp sponge. This action should be taken at shorter intervals if it becomes apparent that residue is accumulating to an undue extent. In service practice the chamber and bore must be examined after each round by No. 2, who must see that all sparks are extinguished and all smouldering fragments are removed from the chamber before the insertion of the powder charge for the next round.

653. At the command or signal **CEASE FIRING**, lanyards shall be detached. If using electric primers the circuit shall be broken. With rapid-fire guns using metallic cartridge cases the breech shall be opened. With machine guns the mechanism shall be put to "safe." If firing is not to be resumed, fixed ammunition and separate powder charges shall be withdrawn. Projectiles not loaded and fused shall be driven back and withdrawn. Separate projectiles loaded and fused shall be left in the gun until a favorable time to fire them; on no account shall an attempt be made to drive them back.

654. Responsibility for the safety of the field of fire rests with the battle commander at battle command practice; and with the fire commander at fire command and battery practice.

655. The battery commander is responsible for all necessary precautions for safety at the battery.

656. No powder charge shall be delivered on the loading platform until the piece is to be loaded.

657. Whenever a junior commander is ordered to fire under circumstances which from his position he judges to be unsafe,

he shall hold fire until he can report the condition to the next higher commander.

658. The careful study and observance of all regulations, orders, and circulars relating to target practice and to the care, handling, and use of powder is enjoined upon all coast artillery officers.

BATTERY SERVICE PRACTICE.

659. Before artillery practice the battery commander shall satisfy himself that all the material to be used at the practice is ready for service, special attention being paid to the following:

Adjustment of observing instruments.

Condition of communications.

Adjustment of plotting board.

Adjustment of sights and sight standards at gun batteries.

Adjustment of azimuth indices at mortar batteries.

Adjustment of range scales of guns and quadrants of mortars, using clinometer.

Condition of recoil systems and setting of the throttling valves.

Condition of elevating and traversing mechanisms.

Adjustment of obturating devices.

Condition of shot trucks.

Weight and condition of projectiles.

Weight and condition of powder sections.

660. Prior to artillery practice the bore, including the powder chamber of each piece to be used in practice, shall be cleaned thoroughly and freed from grease and oil.

661. All powder to be used for target practice at any battery shall be stored in the service magazines of the battery at which it is to be used for at least two weeks before the trial shots are fired.

662. After being stored in a magazine for two weeks the temperature of the magazine may be taken as the temperature of the powder without material error. The temperature of a magazine should be taken immediately upon opening the doors. It is taken at the beginning of each practice and reported on the proper form.

663. Powder of the same lot shall be used for each series of shots from a battery, including trial shots.

664. Powder marked for one caliber or piece must not be used for any other caliber or piece of different chamber capacity.

665. In any case in which poor practice is believed to have been caused by defective powder a special detailed report shall be made to the Chief of Ordnance through military channels.

666. Projectiles shall be cleaned carefully before being inserted in the bore, lubricant removed, and the bourrelets freed of paint.

667. Before record practice or action begins the range correction or probable muzzle velocity for the lot of powder to be used is determined by trial shots.

668. All trial shots are fired at fixed targets permanently located if practicable. The standard pyramidal target supplied by the Ordnance Department is used for both guns and mortars when permanent targets have not been located. If for any reason fixed targets can not be used, the trial shots are fired at points whose azimuths from observing stations are known; instruments are set to these azimuths before each trial shot is fired and splashes observed and plotted.

669. Trial shots should be fired with deliberation, the object being, for guns, to determine the muzzle velocity to be used for the record practice, and, for mortars, the total corrections other than drift to be applied in the record practice. The elevation and azimuth settings are verified before and examined after each trial shot.

670. Careful meteorological observations are taken immediately before firing each trial shot from guns and the data furnished the battery commander concerned.

671. For the 8-inch, 10-inch, and 12-inch rifles, a pressure gauge is used for each trial shot and the pressure recorded.

672. After the trial shots pressure gauges are inserted and left undisturbed during the firing of the record shots. After the firing they are taken out and the pressure recorded as the maximum for the record shots.

673. In practice with gun batteries all projectiles and one powder charge for each gun may be on the loading platform before the command **COMMENCE FIRING**. The powder charges for subsequent shots may be taken from the magazines at the command **COMMENCE FIRING**, but no powder charge shall be carried to the loading or the gun platform, or anywhere in the immediate vicinity of the gun, prior to the discharge of the preceding shot in the series. Breechblocks of both guns and mortars must remain closed completely until the command **COMMENCE FIRING**.

674. In both gun and mortar batteries where the magazines are located so that the ammunition service is delayed, or where the personnel is not sufficient to furnish complete ammunition details, just prior to the practice the powder may be placed at some convenient point in the galleries or in rear of the emplacements or pits; the place selected to be approved by the fire commander.

675. In firing guns by Case II the arbitrary deflection correction for the first shot of a series is applied to the deflection board, but during the firing of a series, deflection corrections from observation of fire are made by each gun pointer independently, as follows:

676. The piece is traversed so that the vertical wire of the sight is kept on the exact point aimed at, and at the instant the projectile strikes, the traversing is stopped and the cross wire moved by means of the deflection screw to the splash;

this may be difficult. As an alternative, gun pointers should be instructed to move the cross wire in the direction of the splash the estimated amount of the error. A change in deflection will be necessary every few shots when the target changes direction or is changing its range rapidly.

677. In firing guns by Case III deflection corrections from observation of fire are ordered by the battery commander and applied to the deflection board.

678. Range corrections from observation of shots fired during a series are made by the battery commander, and only after he has assured himself that there is a consistent error in the ranges for which the pieces are set. At gun batteries this correction is applied on the range board either by the setting of the index to a reference number other than the normal or by means of the velocity curves, preferably the latter. To avoid errors in making these corrections, arrows should be drawn on the range board to indicate the direction in which the marker should be moved. At mortar batteries this correction is applied to the setting of the elevation scale on the mortar arm.

679. Immediately after a piece is fired the breech is opened without command, and, if a vented piece, the primer removed.

680. Care must be taken to prevent injury to the gas-check seat and keep it clean. Sometimes the residue from the priming charge drops from the obturator into the gas-check seat or the breech recess, and should be wiped off.

681. The bore and chamber of the piece should not be washed out during firing. It is seldom necessary to clear the vent except at **EXAMINE GUN**, when all water, oil, or obstructions must be removed. After clearing the vent the primer seat should be wiped clean. Care should be taken to avoid scoring the vent and the primer seat.

682. Immediately after the firing the piece and accessories shall be inspected and a report on their condition made to the district commander; the bores of pieces are washed clean with water, dried and oiled, and the breechblocks dismantled for the purpose of cleaning and oiling the mechanism.

FIRE COMMAND SERVICE PRACTICE.

683. The fire commander conducts the practice from his station and simulates as nearly as practicable an engagement of an independent fire command.

He keeps a record of the orders given to his battery commanders and of the time taken to obey them.

Precautions for safety.

684. Each battery commander acts as a local safety officer for his own battery, and, when necessary for safety, interrupts the firing or suspends the execution of the orders of the fire commander, reporting the circumstances.

685. In so far as they apply, all instructions and rules governing battery practice are observed in fire command practice. Precautions for safety (paragraphs 647 to 658, inclusive) shall be strictly adhered to in fire command service practice.

BATTLE COMMAND SERVICE PRACTICE.

686. The battle commander conducts the practice from his station and simulates an actual engagement as nearly as practicable.

687. In so far as they apply, all instructions and rules governing battery and fire command practice shall be observed in battle command practice. Safety precautions prescribed for battery and fire command service practice shall be strictly adhered to in battle command practice. A record is kept at the battle commander's station of all orders issued and the time required for their execution. This record is included in the report of the practice.

MODIFICATION OF PRACTICE REGULATIONS.

688. If circumstances arise under which it is impracticable to carry out the instructions as given for coast artillery practice, a prompt report to this effect is made to the district commander; in case matters reported are beyond his power to remedy, he forwards the report with recommendations in the case for the action of higher authority.

REPORTS OF TARGET PRACTICE.

689. Before any firing begins, and immediately after its termination, the battery commander inspects the pieces, carriages, platforms, implements, equipments, and other accessories, and, after the practice, makes written reports on their condition to the artillery district commander through the tactical chain of command. These reports are separate on matters affecting each supply department concerned and on those affecting the drill. Pertinent recommendations which the practice or preceding drill and instruction may have suggested for the improvement of the material or the drill should be encouraged by the artillery district commander. If there are no defects to be reported or no suggestions to be made affecting any or all of the staff departments concerned, or affecting the material or drill, a single report embodying that statement will be sufficient. These reports shall be forwarded by the artillery district commander only in cases requiring action of higher authority.

690. Each battery commander submits the reports upon the practice of his battery; he will be held responsible for their prompt rendition and accuracy.

All data called for by the prescribed blanks must be noted, or any omissions explained.

SALUTES.

691. Salutes with cannon shall be fired under the charge of a commissioned officer.

692. The interval between shots is five seconds.

Precautions for safety.

693. Only guns using metallic cartridge cases shall be employed in firing salutes.

694. In firing salutes the chamber of the gun shall be swabbed after each round with a damp sponge to extinguish any sparks remaining from the preceding round and to remove residue. Worn sponges or those that do not fill the chamber of the gun must not be used.

695. Salutes shall not be fired unless the above conditions can be fulfilled.

CHAPTER XV.

NIGHT DRILL—SEARCHLIGHTS.

NIGHT DRILL.

696. Special attention should be given to night drills in order to familiarize the manning parties of the various units with their duties under conditions which would be likely to obtain in time of war and to insure the tactical efficiency of the lighting and searchlight systems.

697. Battery night drill is for the instruction of the fire-control personnel and gun pointers in the use of their instruments and the manning parties of guns and mortars in the use of their equipment at night. Battle and fire command night drills are for the instruction of the command in the use of searchlights and in battle tactics at night.

698. For battery night drill, the tug, without a target, is sent out on the range and kept illuminated by a single searchlight to enable the battery commanders to practice their men in position finding and in service of the guns at night. The movements of the tug may be controlled by signals when necessary.

699. For battle and fire command night drills, the tug, without a target, is sent out a sufficient time in advance to enable it to get beyond the maximum range of the searchlights before the drill begins. At the appointed time it turns and comes in or moves according to instructions. All lights aboard except those absolutely necessary to comply with the laws of navigation are kept extinguished during the drill. The fire-control personnel attend; the remainder of the personnel except gun pointers and traversing details of gun batteries may be excused.

SEARCHLIGHTS.

700. Depending upon the service for which used, searchlights may be classified as fixed, roving, and illuminating.

701. The standard service searchlights are 36-inch and 60-inch, but there are some 24-inch and 30-inch lights still in use.

702. The searchlight officer is stationed in the observing room of the battle commander's station and has tactical functions only. The observing room of the station is equipped with an electric controller for every searchlight under electric control from that station. Speaking tubes connect the searchlight officer with the telephone booths in the telephone room; the telephone operator is in communication with an operator near the searchlight; in the telephone room there are as many booths as there are telephones to the searchlights electrically

controlled from the station, and arrangements are made so that the searchlight officer may be bridged on the various lines.

Manning parties for searchlights.

703. If actuated from a central plant—

Operator.

Assistant.

704. If actuated from a local plant (internal combustion engine)—

Operator.

Assistant.

Engineer.

705. If actuated from a local plant (steam engine)—

Operator.

Assistant.

Engineer.

Fireman.

706. In addition to the above:

Fixed and roving lights, for each—

Watcher (equipped with a night-glass).

Telephone operator.

Service of the lights.

707. Fixed lights are used to keep the outer limit of the battle area illuminated. For this purpose the beam should be moved but little in azimuth and should be given an oscillatory motion up and down so as to cover the water between it and its extreme limits of illumination. In conjunction with this light and on the outside there should be a roving light, which is used to obtain information as to the approach of an enemy at the earliest practicable moment. It may be necessary to have fixed lights on each side of the channel, in which case there should be a roving light for each, and the beams of the fixed lights should be adjusted so as to give a continuous band of light entirely across the harbor entrance. A roving light is used also to do the work of a fixed light when the latter, for recarboning or other cause, goes out of service. Watchers should be stationed on the outside of fixed and roving lights at such distances that they can detect readily any vessel passing into the beam, and anything detected must be reported instantly to the battle commander's station.

708. Roving lights are also provided to search the battle area within the fixed beams.

709. The searchlight area of each roving light is divided into sectors, designated as right, middle, and left, or right, right middle, left middle, and left. These sectors are used for the purpose of controlling the lights by telephone. Fixed

and roving lights are under the direct control of the searchlight officer.

710. When searching, the roving lights are moved slowly back and forth through the designated area, and occasionally given an up-and-down motion. The best method of handling a particular light under the varied conditions which arise can be determined by experience only. The search is maintained through the entire area assigned to the light unless orders are received to search a particular sector. When a vessel is detected by the watcher the fact is reported to the searchlight officer; when a vessel is picked up by the searchlight operator he follows it until ordered to search.

711. Illuminating lights are intended primarily to illuminate targets assigned to the fire commands, and when used for this purpose are under control of the fire commanders, the electrical controllers being at the fire commanders' stations. It may happen often that an illuminating light must be used for searching while a roving light is out of action or is relieving a fixed light.

712. An illuminating light may be used for searching in two ways: First, the fire commander may be directed to search, in which case the searching is done under his orders; second, the searchlight officer may direct the searching by telephone, in which case the operator acts under the orders of the searchlight officer. In order to facilitate the use of illuminating lights for searching, their areas are divided into sectors.

713. Mine lights are under the control of the mine commanders; they are used for searching the mine field and illuminating targets therein, but may be used under the searchlight officer for searching purposes, as in the case of the fire commanders' lights.

714. Except in case of emergency, illuminating and mine field lights are put in use only when ordered from the battle commander's station.

715. Whenever it is necessary to occult a fixed or roving light, to change carbons or for any other reason, report must be made to the searchlight officer before the light is occulted in order that a light may be assigned to relieve it.

716. When two lights are working together, one is designated as the directing light and the other follows its motion, so that the proper intersection of the beams is effected.

717. The normal use of searchlights is as follows: The outside roving light picks up a vessel and follows it to the fixed beam. The approximate position of the vessel and the light covering it are reported to the battle commander. His observer watches carefully for the entrance of the vessel into the fixed beam, and as soon as it is detected by him an inside roving light is thrown upon it, the outside light returning to its proper function. The vessel is followed by the inner light until it is covered by the necessary illuminating light, and assigned as a target to one or more fire commanders; then the inside roving light is given other orders. With fewer

lights the method of using them must be varied to suit conditions.

718. The searchlights in a district are designated by numbers, as No. 1, No. 2, No. 3, etc.

719. Searchlights shall not be thrown on any vessels except those provided by the Government for coast artillery purposes. If by accident a searchlight beam is thrown on any other vessel, it must be removed as soon as the mistake is discovered.

720. It is difficult under the most favorable circumstances for a searchlight officer to exercise accurate control of searchlights by telephone. Therefore it is necessary that the commands be concise and understood easily.

721. Searchlight commands are as given below, but may be modified in order to meet the requirements of local conditions.

IN ACTION signifies that an occulted light is to be put into operation. The command is given as follows: — **IN ACTION**.

OUT signifies to take a light out of action. The command is given as follows: — **OUT**.

SEARCH signifies that the light is to search its entire area. The command is given as follows: — **SEARCH**. If the light is to search a certain sector the command is — **SEARCH RIGHT**, — **SEARCH MIDDLE AND LEFT**, etc. If a light is searching a particular sector and it is desired that it search the full area, the command is — **SEARCH**. If the light is covering a target the command is — **UNCOVER AND SEARCH**.

— **FOLLOW** signifies that the light is to follow a vessel within its beam even if the vessel passes out of the sector which the light has been ordered to search.

— **COVER** signifies that a designated light is to cover a target illuminated by some other light. The command **2 COVER 3** signifies that light No. 2 is to cover the target illuminated by light No. 3. If 2 were on a target already, the command would be **2 UNCOVER AND COVER 3**; the command **COVER** is preceded by **UNCOVER**, so as to indicate to the operator that no mistake has been made; otherwise the operator may consider it his duty to remind the searchlight officer that he is covering a target.

The command — **UNCOVER AND SEARCH** given to a roving light covering a vessel indicates that that light is to uncover and to search its entire area, no matter what the previous order may have been.

FOCUS, SPREAD, CONTRACT, RAISE, LOWER, RIGHT, LEFT, and HALT, are commands to accomplish the objects indicated by them.

If a small motion only is desired when using the commands **RIGHT, LEFT, RAISE, or LOWER**, "**SLIGHTLY**" may be added; otherwise the amount of movement should be indicated in degrees.

At the command **ELEVATE** the beam is raised 30 degrees and held there until further orders.

722. A searchlight operator should be a man of intelligence, and preferably one who has had experience in the use of electrical and mechanical apparatus. A good searchlight operator can be made by careful training and constant practice only. He should be interested in his work and appreciate its importance. Operators should not be changed from light to light, as no two lights require precisely the same handling or adjustment. Operators should be required to experiment with the adjustment of their lights under the supervision of an officer or electrician sergeant.

723. The light must be kept clean, special attention being given to the mirror.

724. The service of a searchlight in proper condition depends largely on the character and condition of the carbons. The best service is obtained when the carbons have been dried thoroughly,

CHAPTER XVI.

COMMUNICATIONS.

725. The means employed for the transmission of orders and information in the coast artillery service are as follows: Wireless for communication between district headquarters, other wireless stations, and boats equipped with wireless outfits.

The telephone for communication between the units of the tactical chain of command.

The telautograph or other electrical or mechanical device for transmission of information from the plotting room to the gun platforms or mortar pits.

Speaking tubes for communication between the battle commander's observing room and the telephone booth of his station, between fire commanders' stations and near-by battery commanders' stations, between emergency stations and plotting rooms, and as an auxiliary means of communication between plotting rooms and emplacements or powder magazines.

Flags, heliographs, and other means of signaling for communication between posts and between posts and boats when wireless or other means of communication are not installed.

726. The means of communicating throughout a battle command are illustrated in the diagram, page 150.

Signal stations.

727. Signal stations are established at each coast artillery fort. These stations are equipped with telephones to post switchboard, and such other equipment, including wireless outfits, as may be prescribed in War Department orders. The stations are in charge of the operators necessary for their proper service.

Telephone service.

728. The proper use of the telephone requires careful training. Care should be taken in selecting operators; the men should be tested as to their ability to distinguish sounds in a telephone. The following method is suggested:

Enunciate distinctly through the telephone letters which sound somewhat alike, as B, C, P, T, E, and ascertain whether they can be distinguished readily; enunciate a number of words beginning with S, such as seven, six, sight, sound; try such words as four, more, score, door, bore.

729. After a test of this kind with an instrument in good order, try with an instrument which is not working well.

730. After the hearing test, give a number of selected words to be sent through the telephone to test the operator's ability to enunciate distinctly.

731. Other qualifications being equal, men should be selected who are in the habit of speaking slowly and distinctly. A man who raises the pitch of his voice when excited should not be selected.

732. Operators should have a sufficient knowledge of their instruments to correct minor defects, such as loose or corroded contacts, or bent levers.

733. When preparing for service the operators arrange their apparatus for communicating and raise and lower the hook switch. If this operation results in a sharp click in the receiver, the battery is in working order. If no click is heard, the binding post to which the head sets are connected should be examined and tightened. If the hook test indicates that there is no battery on the line, the operator must notify the electrician sergeant. The principal operator on each line calls up all the others on his line and reports to the chief of his station.

734. The tests for telephones are found in Signal Corps Manual No. 8.

735. Particular stress should be laid on the importance of training each telephone operator to take an interest in the instrument used by him. If each operator takes proper care of his instrument the efficiency of the system is much enhanced. The talking set should be hung in its proper place at the completion of drill, hook springs should be in place, the cords should be kept clear of possible interference, and a report should be made promptly of any defect in the talking circuit.

736. The nickel plating should be kept polished with chamois; the connections external to the transmitters and receivers should be examined often for possible corrosion and a strip of hard-surfaced paper drawn between platinum contacts to insure their cleanliness. Cords should be examined frequently for wear just behind the tips.

737. Transmitter shells must not be opened by the operator under any circumstances.

738. Report must be made to the electrician sergeant in charge of the equipment as soon as there is any indication of trouble, in order to avoid discontinuance of the service.

739. In sending messages observe the following rules:

1. Speak into the transmitter holding the head in a natural position, the lips about an inch from the transmitter.

2. Use a moderate tone of voice and speak slowly and distinctly, being careful not to slur the words or syllables, but to enunciate clearly each sound.

3. Never shout or raise the pitch of the voice.

4. Send numerals singly; thus, 4370 is sent *four, three, seven, zero*. Never use the letter O for zero. In sending an

azimuth, or any number involving a decimal, the decimal point is called *point*; 246.34 is sent *two, four, six, point, three, four*. An exact hundred is sent as a hundred; thus 200 is sent as *two hundred*, 4500 is sent *forty-five hundred*. The same system applies to sending an exact thousand; 4000 is sent *four thousand*.

5. If it is necessary to repeat, use more care as to distinctness, but do not raise the voice. A single number not understood may be accentuated by counting up to it and emphasizing it. Thus if the figure four is not understood, say *four*; one, two, three, *four*.

740. In receiving messages observe the following rules:

1. Keep the mind on the message; a person can not receive correctly when he is thinking of something else.

2. Keep the receiver close to the ear.

3. Do not interrupt the sender unless absolutely necessary.

Telautograph service.

741. The electrician sergeant in charge of equipment is responsible for the adjustment and repair of telautographs. The operator keeps the instrument clean, the ink bottle full, pen in condition, and puts in the paper.

742. To operate the telautograph the operator closes and opens the master switch, adjusts the voltage rheostat, writes the message, and shifts the paper.

743. To close the master switch, depress the button latch with the point of the pencil, pull the lever of the switch, then lift the pencil thus releasing the latch; this will lock the lever and keep the switch closed.

744. To open the master switch, depress the button with the pencil; this will release the lever and the switch will fly open.

745. To shift the paper, depress the button latch with the point of the pencil, and hold it down during the entire operation; then move the lever back and forth its full stroke as many times as may be necessary; each stroke shifts the paper a certain amount. If the writing is to be continued after shifting the paper, the switch should be left closed, otherwise it should be opened.

746. To adjust the voltage, close the master switch, move the pen along the edges of the platen (called making a field), and note the result on the receiver; if the proper rectangle appears on the receiver the voltage is correct; if not, the voltage is varied by the rheostat until the rectangle is proper.

747. To test the telautograph for service, the operator turns on the power, closes the master switch, makes a field, and writes a message. The range setter telephones to the station how his receiver is working. Report is made to the chief of detail, and if everything is not working properly the electrician sergeant is notified at once.

748. In using the telautograph:

1. Never depress the button with anything but the telautograph pencil.

2. Hold the pencil as nearly vertical as possible.

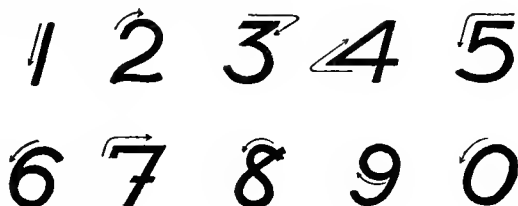
3. Do not rest the hand on the platen, otherwise the pen at the receiver will not lift, as the lifting of the pen is accomplished by allowing the platen to rise when the pencil is lifted.

4. See that the lead in the pencil protrudes a sufficient distance and is sharpened properly.

5. Write in a clear round hand.

6. Always open the master switch when the message is complete. This is exceedingly important.

7. Make figures as follows, the arrows indicating the direction in which the pencil moves:



CHAPTER XVII.

FIRE-CONTROL APPARATUS.

ATMOSPHERE BOARD.

749. Figure 2 shows the atmosphere board.

750. The operation of the board is self-evident. The arguments are the barometer and thermometer readings, and the result obtained is the reference number to be used on the range board in determining the range correction for atmospheric conditions.

Aeroscope.

751. See Signal Corps Manual No. 8.

ANEMOMETER.

752. The anemometer consists of four hemispherical aluminum cups mounted on arms and a spindle so as to revolve under the action of the wind and to record its travel on a dial. In order to determine the wind velocity the anemometer is connected electrically in some cases with a device by means of which a stop watch is started or stopped whenever the anemometer closes an electrical circuit. The face of the stop watch is graduated to read the velocity of the wind in miles per hour. The first closing of the circuit starts the watch, the second stops it, and the third closing brings the hand back to zero. This operation is repeated continuously, a record of the velocity of the wind being obtained for every three closings of the circuit. There is ample time between the second and third closings to read the velocity of the wind. In case the electrical device is not provided, the watch may be started and stopped by hand, the proper instant being indicated by a bell or sounder. The record sent to the fire commanders' stations should be the mean of ten readings.

AZIMUTH INSTRUMENT.

753. Figure 3 illustrates the azimuth instrument. It may be mounted either upon a tripod, as in the figure, or upon a pier mount. It is used for measuring azimuths.

754. The instrument is said to be oriented when it is set up so that it will read azimuths. The operation is as follows:

First. Set the graduated circle and index to read the azimuth of a known datum point.

Atmosphere Board.

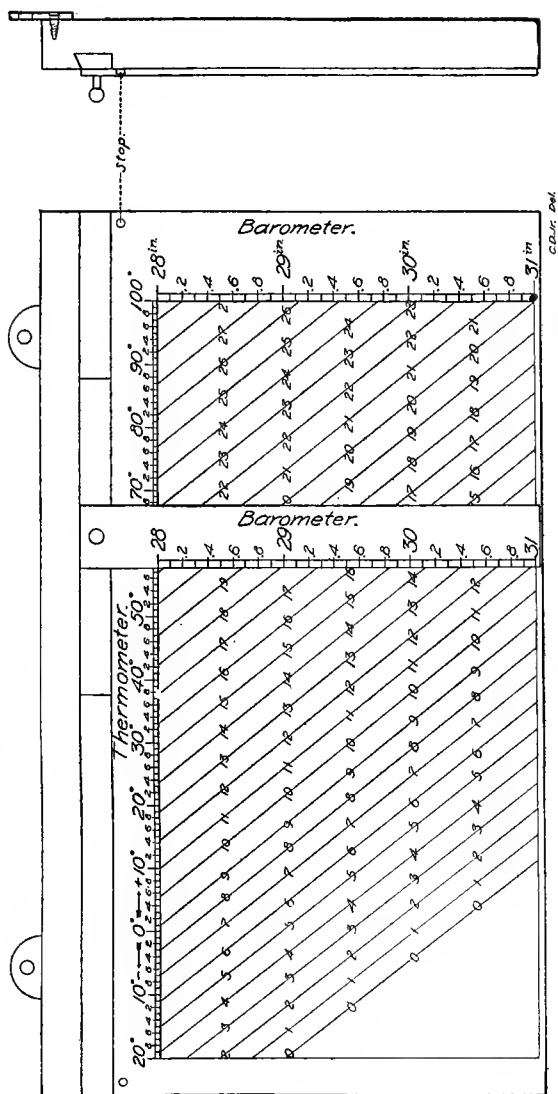


Fig. 2.

Second. With the azimuth clamp screw loosened, set the eyepiece slightly to the left of the reading window and clamp the azimuth clamp.

Third. Raise the whole instrument by grasping the top and turn it so that the telescope points in the general direction of the datum point with the plumb bob over the home station. In orienting the instrument on a pier mount, the instrument may be turned in the proper direction by loosening all of the leveling screws.

(Second and third are not essential to the reading of azimuths, but are provided so that when the adjustment is complete the parts of the instrument will be in the most convenient relative position for operation and reading.)

Fourth. Level the instrument. See that all the screws have a uniform and firm bearing on the leveling plate; set one of the levels exactly over two opposite leveling screws; turn the screws in opposite directions until the bubbles of each level are exactly in the middle, being careful to maintain a firm bearing of the screws on the plate. Turn the instrument through 180 degrees and correct one half of any variation of either bubble by the adjusting screws on the level, the other half by the corresponding leveling screws. Repeat this operation until the bubbles remain in the middle of the tubes for any position of the telescope in azimuth.

Fifth. Focus the telescope, paragraph 820.

Sixth. Bring the vertical wire of the telescope approximately on the datum point; tighten the azimuth clamp, and, using the azimuth slow motion screw, bring the vertical wire exactly on the datum point. Clamp the slow motion.

755. The instrument is now ready to read azimuths. In using it, the vertical wire must be set accurately on the designated point of the object observed. In case of moving objects it is essential also that this setting be made at the designated instant.

BAROMETER.

756. Both the mercurial and aneroid barometers are hung in the meteorological station. The aneroid barometer is always used for determining atmospheric data, the mercurial barometer being used to adjust the aneroid. To use the mercurial barometer for ordinary work involves too much loss of time.

DEFLECTION BOARD.

(See also mortar deflection board.)

757. The deflection board is an adding machine by means of which the corrections for travel in azimuth during the observing interval, for travel in azimuth during the time of flight, and for wind and drift, are added algebraically. The total azimuth correction to be made on the gun arm, or the

AZIMUTH INSTRUMENT.

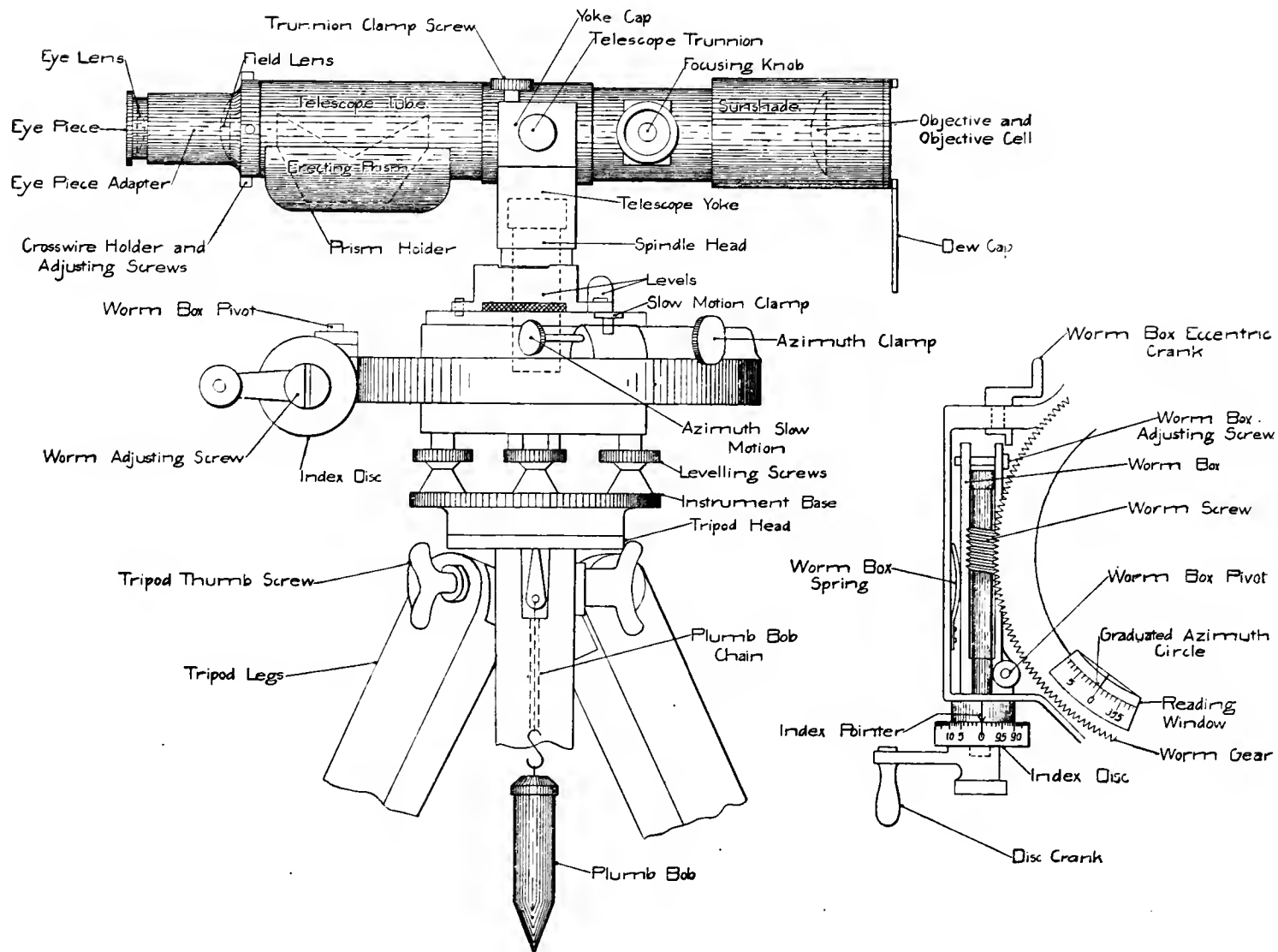


Fig. 3.

Fig. 4.

deflection to be set on the sight is indicated on the proper scale of the instrument.

758. The instrument consists of a base B, figure 4, upon which slides a movable frame A, called the platen; this frame slides on the rod C, to which it is attached by means of two lugs NN. In the left-hand lug there is a set screw M, by means of which the platen may be clamped to the rod C.

The rod C is attached to the base by the two brackets K and Q. In the bracket K is a threaded sleeve L, which can be turned by the milled head J, thus giving a slow motion to the rod, and consequently to the platen.

Attached to the base at the lower side are three scales. Two of these, the deflection scale and travel scale, are fixed, and the azimuth correction scale is movable. (The travel scale is no longer needed in the use of the board.)

On the left-hand side and attached to the base is the wind arm F and the wind arc G.

Attached to the platen is the platen scale I, over which moves the travel arm D. The scale I can be given two positions on the platen, one corresponding to a time interval of 15 seconds and one to a time interval of 20 seconds. (The latest boards are made for observing intervals of 15 and 30 seconds.)

Over all moves the T square E, which also slides on the rod C. On the face of the T square there is a range scale called the T square scale.

Attached to the left side of the platen is a piece of metal H, called the leaf. The curved edge of the leaf is a drift curve. On the left there is a range scale, which is used in setting the platen for wind and drift. This is called the leaf range scale.

759. **Platen scale.**—This is a scale representing travel in azimuth; it is graduated in degrees and hundredths, scale one-half of a degree to the inch. It is numbered from left to right, and the reference number at the origin is 15° , to correspond to the azimuth degree tally dial on the plotting board.

760. **Deflection scale.**—This scale indicates the deflection to be used on the sight in Case II, scale of half of a degree to the inch. It is numbered from left to right, with 3° in the center to correspond to the reference numbering on the sight scale.

761. **Azimuth correction scale.**—This scale indicates the correction to be applied to the gun arm on the plotting board in Case III. The scale is one-half of a degree to the inch, and it is numbered from left to right with 15° in the center to correspond to the numbering of the azimuth correction scale on the gun arm.

762. **The wind arc.**—The arc is graduated for wind components varying by 10 miles per hour. The origin (zero wind) is the graduation numbered 50, and the corresponding position of the wind arm is normal, that is, perpendicular to the deflection scale. The reference number zero corresponds to a left wind component of 50 miles per hour. The reference

number 100 corresponds to a right wind component of 50 miles per hour. The wind arm is set to the proper reference number by the arrow index.

763. T-square scale.—This scale, although graduated in yards of range, is a scale of times of flight. The range numbers are placed at a distance from the zero of the scale corresponding to the time of flight for the range. The time scale is five seconds to the inch. The origin of the time scale for the board is the center of motion of the travel arm.

764. The leaf range scale.—This is a non-equicrescent scale constructed so that the correction for wind and drift is applied by a single setting.

765. For subcaliber practice.—A special leaf scale and scale arm for the T-square are used. When not supplied paper scales should be constructed.

Operation.

766. First. Set the wind arm to the proper reference number, as indicated by the wind component board.

Second. Set the platen so that the point of the drift curve corresponding to the range will be accurately over the right-hand edge of the wind arm.

Third. Set the travel arm (right edge) for travel reference number as received from the plotting board.

Fourth. Set the azimuth correction scale so that the travel reference number is under the normal of the deflection scale.

Fifth. Set the T-square so that the point of its scale corresponding to the range will be accurately over the right edge of the travel arm.

The bevel edge of the T-square then indicates:

(a) On the deflection scale the deflection to be used on the sight with Case I or II.

(b) On the azimuth correction scale the correction to be applied to the gun arm, when using Case III.

767. The foregoing operation, when used for Case III, is based upon the assumption that the guns can be laid continuously for azimuth as well as for range and can be fired when ready. With guns on disappearing carriages there is a delay in traversing while the truck is at the breech, but experience has shown that a well-trained detachment can pick up the time azimuth relation easily while the breech is being closed and the gun going in battery.

768. For use with systems of firing at a predicted point which require more than one observing interval to lay the gun in azimuth two multiplying scales are furnished with each board to be attached to the semicircular brace of the platen. One of these scales is intended for use when a fifteen-second interval is employed and the other with a twenty-second interval. They permit the making of allowance for travel during time of flight plus the travel during two observing intervals.

All of the operations are the same except the fourth, which reads as follows:

Fourth. Set the azimuth correction scale to the reading of the multiplying scale.

DEPRESSION POSITION FINDER.

769. Depression position finders are instruments for determining the position of an object by means of its azimuth and range. The azimuth features are similar to those described in paragraphs 753 and 754. The range is determined by measuring the angle between the horizontal and the line from the instrument to the water line of the object, the measure of the angle being read directly from the instrument as the range. In addition to accurate setting of the vertical wire for azimuth, as in the case of azimuth instruments, the horizontal wire must be set accurately upon the water line of the object observed.

Adjustment of the Swasey D. P. F.

770. 1. Level the instrument carefully (par. 754).

2. Focus the telescope (par. 820).

3. For reading azimuth angles the instrument must be oriented by setting the azimuth of a known point on the scale and bringing the vertical wire exactly on the point by means of the azimuth adjusting screws. The holding down bolts for the base are situated so that the instrument is oriented approximately when the base is placed properly on the bolts.

4. The adjustment for reading ranges is made as follows: (It is assumed that datum points at short, mid, and long range, D1, D2 and D3, have been established.)

(a) Set the height scale to indicate the height of trunnions of the instrument corrected for tide.

(b) Set the range drum to read the range of D3 and direct the telescope on that point; water line by means of the micrometer screw.

(c) Set the range drum to the range of D1, turn the telescope on it and water line by moving the top carriage along the height scale by means of the carriage knob.

(d) Repeat (b) and (c) until the adjustment permits approximately correct readings on D1 and D3.

(e) Then test on D2; should the difference between the range reading and the true range be small, no change in adjustment need be made. Should this difference be material, D2 should be substituted for D3 or D1 in (b) and (c) depending on the range at which the instrument is to be used; (for D1 if a longer and for D3 if a shorter range than D2).

771. This adjustment once made, should be checked from time to time.

772. Where no datum points have been established, the method of adjustment is similar to that given above by making use of buoys or other fixed objects that can be water lined and the ranges to which have been determined previously by the horizontal base system. As far as practicable they should be at long, mid, and short ranges, corresponding to D1, D2, and D3 above.

773. If reference marks have been established on one or more datum points, set the height scale for the height of the trunnions of the instrument above the reference mark, and with the range drum set to read the correct range make the horizontal wire coincide with the reference mark by means of the micrometer. Set the height scale index to indicate height of the trunnions of the instrument corrected for tide and proceed as in (b), (c), and (d) above, or if the tide is not known, water line as in (c), and repeat (b), (c), and (d) as before.

Adjustment of the Lewis D. P. F., model 1907.

774. The Lewis D. P. F., model 1907, consists of a pedestal on which are mounted two trains of gears which operate respectively the range and azimuth scales. The inclination of the telescope is given by means of a double screw, which insures constant parallelism of the graduated arm on which the height scale is laid off and which transmits the motion of the screws directly to the telescope. The index slide on the height scale carries a refraction screw.

775. To correct automatically for a variation in height a cam attachment operates a slotted bar which is connected with the refraction screw.

776. Rapid changes in azimuth are made by turning the upper plate of the instrument, the friction of the gear not offering enough resistance to prevent this; slow changes in azimuth are made by turning the azimuth head.

777. This instrument has three leveling screws. To level it: Set one of the levels over two of the screws and turn the screws in opposite directions until the bubble is in the middle. Bring the bubble of the other level to the middle by means of the third leveling screw alone. Turn through 180 degrees and correct as provided in paragraph 754.

778. When the instrument is leveled but one adjustment for range reading is necessary. This is made as follows: Set the height scale to correspond to the height of the trunnions of the instrument corrected for tide. Set the range scale to the range of a datum point, preferably one at mid-range. Water-line the datum point by means of the refraction screw.

779. For reading azimuth angles the instrument must be oriented by setting the azimuth of a known point on the scale and bringing the vertical wire exactly on the point by means of the spanner wrench provided for turning the instrument on the pedestal.

Mortar Deflection Board.

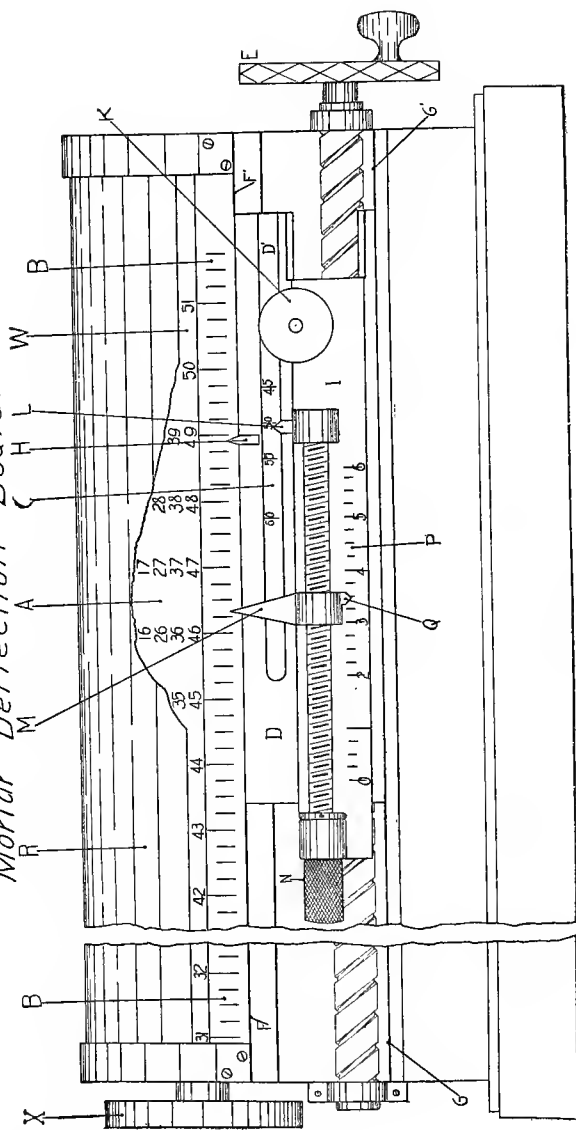


Fig. 5.

PLOTTING BOARD.

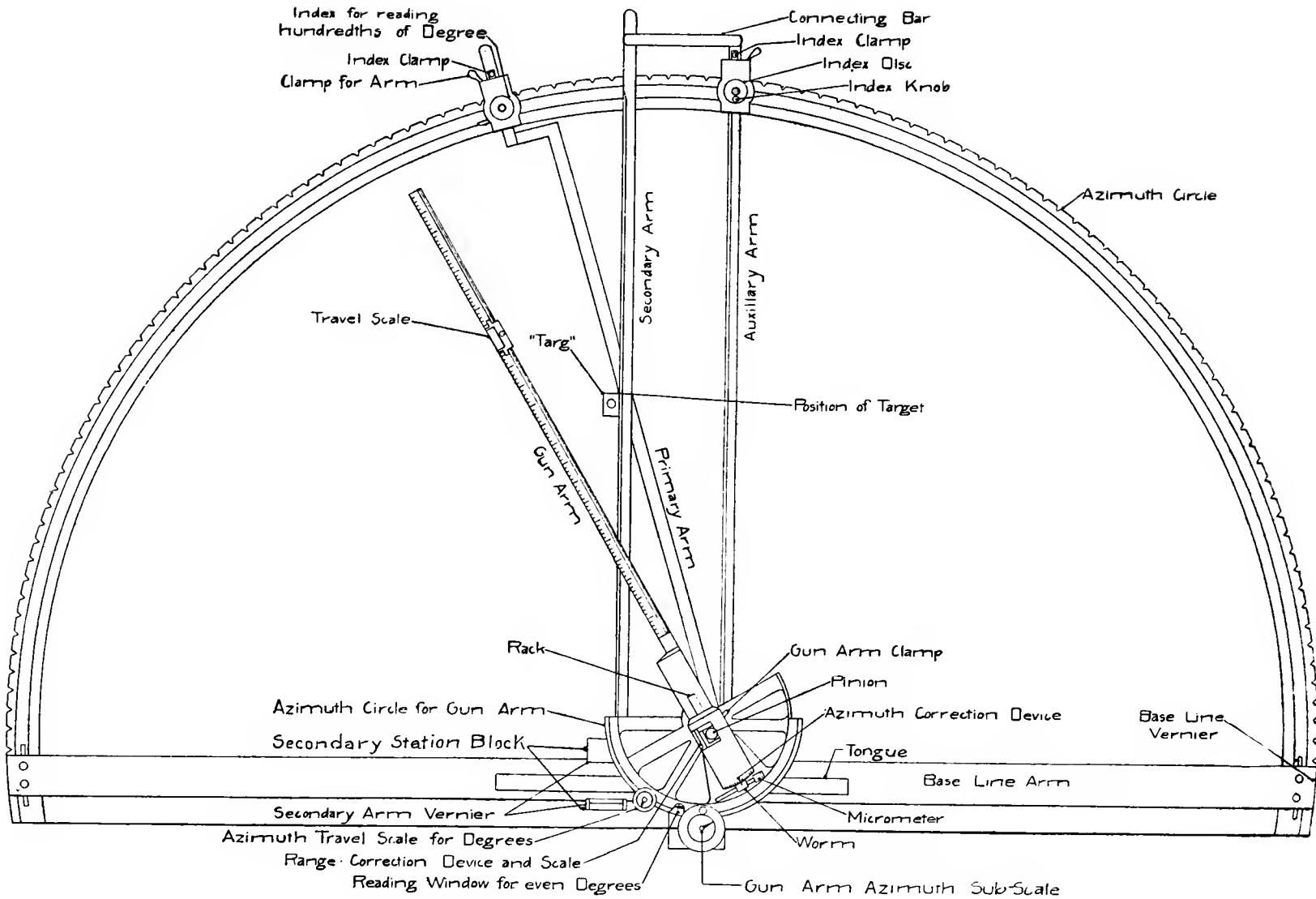


Fig. 6.

MORTAR DEFLECTION BOARD.

780. The mortar deflection board is illustrated in Figure 5. It consists of a cylinder A, on the elements of which are numbered, consecutively, azimuths from 1° to 21° , from 11° to 31° , etc., the last series running from 351° through 0° to 11° . The degrees only are on the cylinder, the azimuth subscale B giving the subdivisions to 0.05° . Any desired series may be brought into the slit on the shield R by turning the head K. Immediately below the subscale B is the drift scale C on the drift-scale slide D', which is carried by the carriage D. The carriage is moved by turning the main traversing wheel E. There is a pointer H on the carriage for setting to any azimuth on the subscale. The carriage I may be moved by the head K independently of the carriage D. On the carriage I there are two pointers, the first, L, for setting the elevation on the drift scale C, the second, M, for indicating the corrected azimuth on the subscale B. The pointer M may be given an independent motion by the head N; the amount of this motion is indicated on the deflection scale P by the pointer Q.

781. The construction of the board depends upon the theory that the angular drift is constant for a given elevation whatever the velocity. Its operation is as follows: Set the pointer H to the plotting-board azimuth of the set-forward point, bringing the proper degrees on the cylinder into view by means of the head X. Set the pointer L for the elevation as determined from the plotting board. If no arbitrary correction as a result of observation of fire is to be made, set the pointer Q to 3° , the normal of the deflection scale. The pointer M now indicates the azimuth of the set-forward point corrected for drift. Arbitrary corrections may be made at any time by setting Q to the proper reference number.

PLOTTING BOARD.

Orientation of the board and gun arm center.

782. The base-line arm may be moved through 1 degree either way and set to the proper reading by means of verniers attached to each end. The zero of the fixed scale of the vernier on the main azimuth circle opposite the vernier on the base-line arm may be assumed to correspond to any convenient degree number, depending upon the azimuth of the base line. It is convenient to consider the zero opposite one end of the base-line arm as corresponding to the nearest degree of the back azimuth ($180^{\circ} + \text{the azimuth}$). For example, assume that the azimuth of the base line was 212.14° , and that the base line was left-handed. Then the zero of the scale opposite the left-hand end of the base-line arm would correspond to 212° , and the zero of the scale opposite the right-hand end would correspond to 32° . To orient the base-line arm to correspond with the actual base, it is necessary to swing the base-line arm clockwise through 0.14° ; that is, set the left end to 212.14° . The other would, of course, be set at 32.14° .

Assume that the azimuth of the base line was 212.80° , then the left end would correspond to 213° , and the right end to 33° . To set the base line at 212.80° it would be necessary to swing the base-line arm counter-clockwise through 0.20° . In other words, the left-hand end is to be set at 212.80° , and the right-hand end at 32.80° .

783. To prevent error it is important that both verniers should be used, and both ends be set accurately.

784. The main azimuth circle and the gun azimuth circle of all boards issued are numbered at Frankford Arsenal in accordance with information furnished from the post at which the board is to be used. This information includes a statement of the azimuth of the normal to the base line, of the position of the secondary station with relation to the primary, and of the length of the base line.

Bring the gun-arm center over the primary center by placing the zeros of the longitudinal adjusting slide verniers and the lateral adjusting slide vernier coincident with the zeros of their respective scales. Be sure that the zero of the worm guard is opposite 15 on the azimuth correction scale, and the scale on the micrometer head of the worm is at zero. Bring the primary arm to the normal line of the board. Be sure that the pointer of the index box on the primary arm is at zero. Place the targ against the reading edge of the primary arm, and bring the gun arm carefully against the targ. If done properly, the reading edges of the primary and gun arms will coincide with the normal line. Set the azimuth pointer at the gun-arm azimuth window, by means of the adjusting screw, to the whole degree of the azimuth of the normal line. Next, set the gun-arm azimuth subdial indicator to zero by loosening the screw holding the indicator in place. This will allow of an adjustment of one-fourth, one-half, or three-fourths of a degree. If this is not sufficient, the tally subdial is removed. The inner dial face can be adjusted now within the limits of one-fourth of 1 degree by loosening the retaining screw and moving the dial until the pointer is at zero.

785. To verify this setting, the gun arm should be moved away from the targ and brought up to it several times. The gun-arm center is moved to the position on the board corresponding to the position of the gun by moving the adjusting slides the required distances in the proper directions, depending on the coordinates of the directing point, the primary station being taken as the origin.

786. Each board is given a serial number, stamped on the name plate and right-hand end of the azimuth circle.

787. For subcaliber practice.—To provide for reading shorter ranges than are shown on the gun arm the graduations may be carried back to the inner end of the arm by the use of a paper scale pasted on the side of the arm, or the normal of the range correction scale of the gun arm and the ruler of the range board may be taken as 2,400, and a paper scale pasted on the gun arm showing ranges from 1,400 to 3,500 yards.

Plotting board for mortars.

788. The mortar plotting board is the same as above described, except that a mortar arm provided with a sliding scale graduated in degrees and minutes of elevation and times of flight for each zone, and a gun center with a larger azimuth circle, are substituted for the gun arm and gun center. The corrected elevation is read directly from the scale on the mortar arm.

789. The azimuth read from the mortar arm azimuth circle is corrected for drift, by means of the mortar deflection board.

790. For subcaliber practice at mortar batteries the scale of the plotting board may be increased to 150 yards to the inch where local conditions permit. Unless subcaliber scales of 150 or 300 yards to the inch have been supplied, an elevation scale for attachment to the mortar arm conforming to the scale at which the board is to be used should be constructed at the post.

Plotting board for fire commanders.

791. The plotting board for fire commanders is similar to the ordinary board, but has in addition a pantograph attachment and a reverse plot of the location of the batteries and stations. The gun center is mounted on ball-bearing lateral and longitudinal slides. It may be set over any desired point by means of the pantograph, the stylus attached to one of the arms of the pantograph being set over the corresponding point on the reverse plot. The important points on the reverse plot such as the directing points of the batteries, position finding stations, etc., are marked by small holes for the accurate setting of the stylus.

POWDER CHART.

792. The powder chart is a chart to determine the velocity to be expected from a given charge of powder considered as a function of the temperature of the powder. It is constructed at the post and used in connection with a T-square, as shown in figure 7. The velocity scale is at the top of the chart. The T-square is graduated on the left edge for temperature.

The velocity scale at the top of the chart is graduated 10 f. s. to the inch; it reads from left to right. The normal velocity for the gun is placed in the center. In the figure this is taken as 2,250 f. s. A convenient length for the chart is 20 inches, which allows for a variation of 100 f. s. on each side of the normal. The left edge of the T-square is graduated in degrees Fahrenheit, beginning at -10° at the bottom and ending at 100° at the top. A convenient scale is 10° to the inch, which requires a chart about 13 inches wide.

793. To construct the temperature-velocity curve.—Draw a horizontal line on the chart which will pass through the 70° mark on the T-square, and consider this the axis X. Draw a line at right angles to this through the normal velocity and

consider it the axis Y . Then determine coordinates of points of the curve from the data contained in tables published from

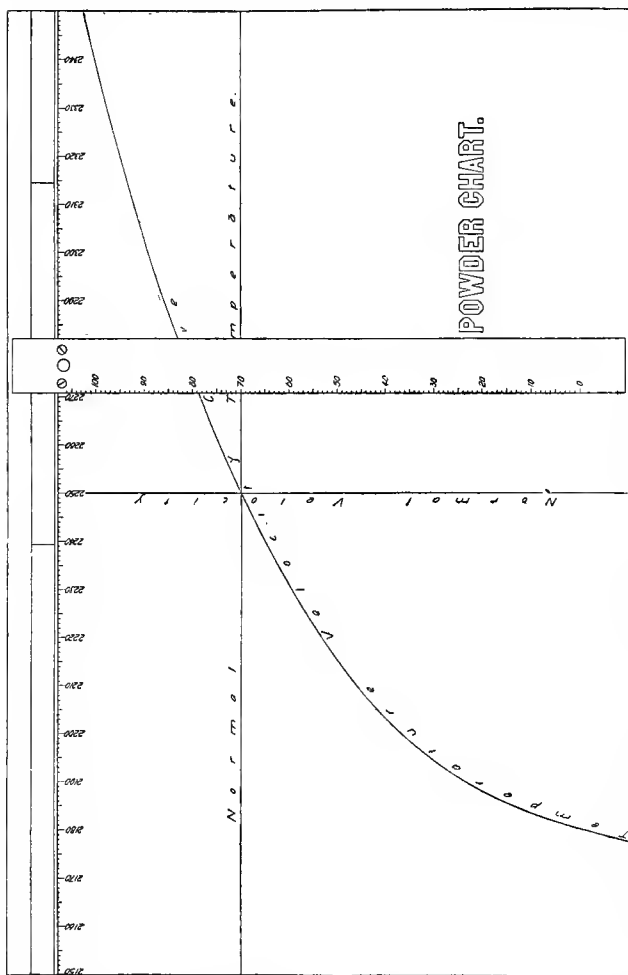


Fig. 7.

time to time in general orders from the War Department. (See General Orders, No. 23, War Department, 1909, p. 4.)

RANGE BOARD

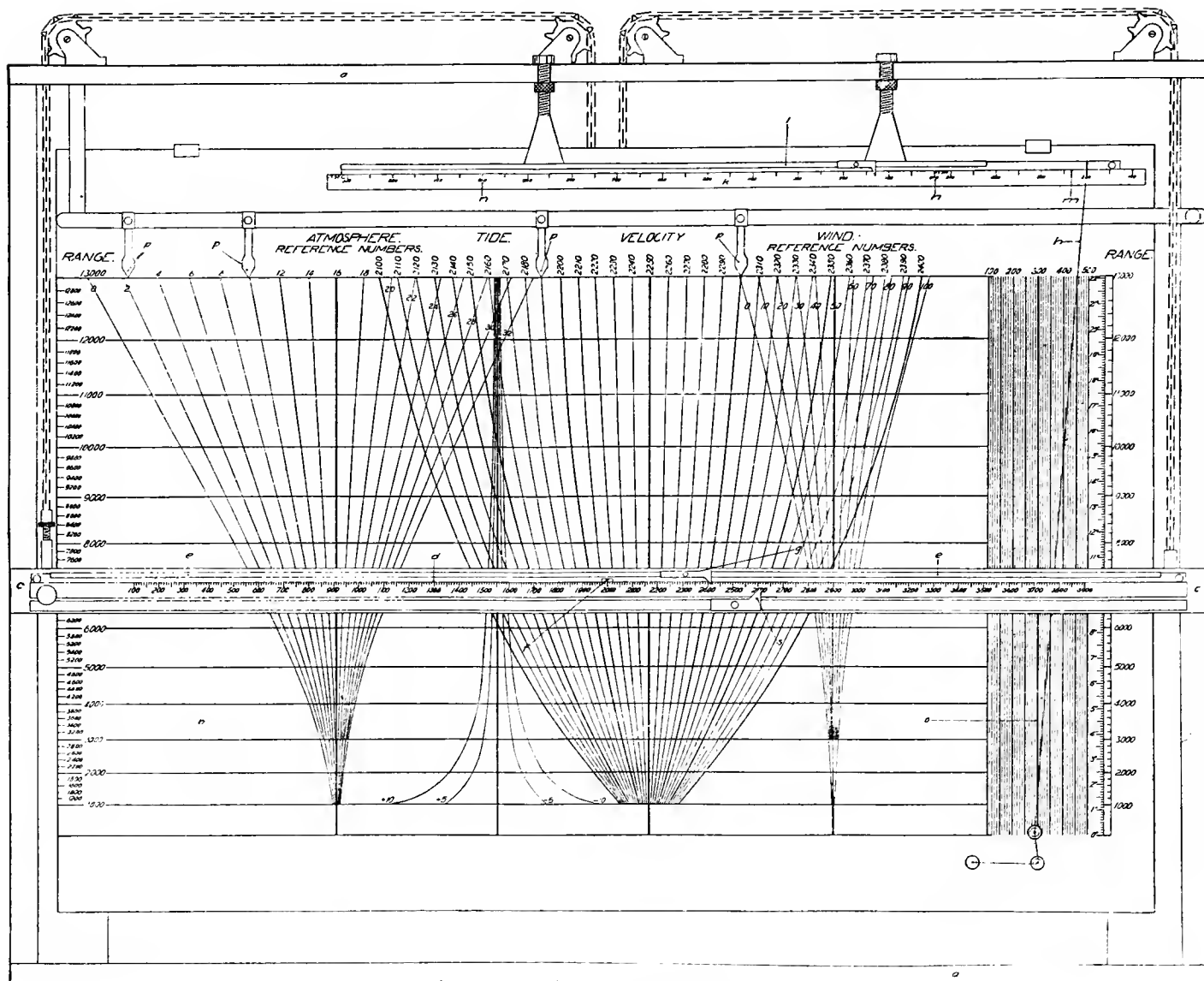


Fig. 8.

The ordinates are the temperatures and the abscissæ are the corresponding variations from the normal muzzle velocity. Plot the points and draw a curve through them.

794. To use the chart.—For powder tested and adjusted to give the normal velocity of the chart at 70° F., set the T-square so that the actual temperature of the powder lies on the curve and read the velocity to be expected from the charge from the velocity scale on the left edge of the T-square.

795. For powder tested and adjusted to give the normal velocity at some temperature other than 70°, set the T-square for the temperature at which the powder was tested and read the velocity. This is called the "test setting." Then set the T-square for the actual temperature of the powder and read the velocity. This is called the "temperature setting." Subtract the velocity of the test setting from the velocity of the temperature setting and add this difference algebraically to the normal velocity for the gun, and the sum will be the velocity to be expected from the charge.

Example 1.—Normal velocity, 2,250 f. s. Velocity for test setting, 2,240 f. s. Velocity for temperature setting, 2,280 f. s. $2,280 - 2,240 = +40$; $2,250 + 40 = 2,290$ f. s., the probable velocity.

Example 2.—Normal velocity, 2,250 f. s. Velocity for test setting, 2,240 f. s. Velocity for temperature setting, 2,220 f. s. $2,220 - 2,240 = -20$; $2,250 - 20 = 2,230$ f. s., the probable velocity.

796. Weights of powder charges.—It is sometimes necessary to change the weights of powder charges. The velocity to be expected due to such changes may be computed from the formula:

$$\frac{V}{V_1} = \left(\frac{W}{W_1} \right)^y$$

The average value of y is: For nitrocellulose powder, 1.2; for nitroglycerin powder, 0.8.

RANGE BOARD.

797. Nomenclature:

- a. Frame.
- b. Board.
- c. Ruler.
- d. Scale on the ruler.
- e. Main bar.
- f. Index.
- g. Pointer.
- h. String.
- k. Travel ruler.
- l. Travel bar.
- m. Travel scale.
- n. Travel range scale.
- o. Prediction scale.
- p. Marker.
- s. Tally.

General description.

798. The range board is a computing device used to determine the range corrections to be applied to the gun arm of the plotting board. It consists of a frame in which can be placed in fixed position a graphic range correction chart pasted on a board. In front of this chart is a balanced horizontal ruler, which can be moved up or down and set opposite any range on the chart. The ruler is maintained in position by supporting sprocket chains and counterpoise.

799. The only adjustment required is to set the ruler parallel to the horizontal lines on the board; this adjustment is made by means of the adjusting screw on the left of the frame, which shortens or lengthens the left-hand support of the ruler.

800. On the ruler is a scale of yards, 100 to the inch, a movable bar and a sliding pointer; these three elements in connection with the graphic chart constitute a mechanical means for adding algebraically the various corrections. The horizontal scale of the chart is also 100 yards to the inch.

801. The origin of the correction scale on the gun arm on the plotting board is numbered 2,000, in order that the correction to be made thereon shall never be negative. This requires 2,000 to be taken as the origin of the scale on the ruler.

802. The curves on the chart indicate the magnitude of the corrections to be added or subtracted, and the ruler performs mechanically the addition or subtraction.

803. The curves are drawn for every 2 per cent variation in the density of the air, for every 10 f. s. M. V., for every 5 feet of tide, and for every 10 miles of wind. For conditions when the values lie between these least readings, the pointer can be set by the eye closely enough for all practical purposes. The vertical line in the center of each set of curves is called the normal.

804. Reference numbers are used instead of two sets of numbers of the same magnitude with plus and minus signs, to avoid liability of error. Thus, if the wind curves were numbered in both directions from zero, there would be a + 10 mile wind curve and a - 10 mile wind curve, and the wrong curve might be used; the corresponding reference numbers for wind are 40 and 60, and the possibility of confusion on account of the plus and minus signs is avoided.

805. On the upper edge of the board is placed a rod which carries the markers. They are used to mark the particular curves which apply to the given set of conditions.

806. The travel ruler is fastened to the top of the frame in a position parallel to the horizontal lines of the chart. It is used in determining the range corrections for travel of the target during the time of flight and observing interval.

807. No modern ship can travel more than 300 yards in fifteen seconds (the usual observing interval), therefore the

origin of the travel scale on the gun arm of the plotting board has been numbered 300, and the same reference number must be used for the origin of the travel scale and the normal of the prediction scale on the range board. For convenience of computation, the numbers on the travel scale which run from 0 to 600 read from right to left, while those on the prediction scale also run from 0 to 600 read from left to right.

Operation.

808. 1. Adjust the ruler.

2. Set a marker to the curve corresponding to the atmosphere reference number.

3. Set a marker to the curve corresponding to the height of tide.

4. Set a marker to the curve corresponding to the velocity assumed for the first trial shot.

5. The wind component indicator having been set for the azimuth and velocity of the wind and the azimuth of the target, note the range reference number and place a marker at the top of the wind curve having that number.

6. As soon as the approximate range is given set the ruler for the range and the index at the origin of the scale; slide the pointer opposite the atmosphere curve indicated by the marker, holding the bar in place with the left hand; slide the bar until the pointer is at the normal for atmosphere; this completes the correction for atmosphere.

7. Proceed in a similar manner for wind.

8. Proceed in a similar manner for tide.

9. Proceed in a similar manner for velocity.

10. Set the travel bar with the index at the normal (300) and its sliding pointer at the first range called. When the next range is called move the travel bar until the pointer is at the second range. Slide the pointer on the main bar until it is opposite the string, then move the bar until the pointer is opposite the vertical line corresponding to the travel as indicated by the position of the index on the travel bar.

11. Then the index indicates the setting of the correction scale on the gun arm for the total range correction to be applied.

809. Always hold the bar firmly while moving the pointer.

810. In making corrections the density of the air, the velocity, and azimuth of the wind at the opening of the action will usually suffice for the entire action.

811. The height of the tide should be obtained at least every half hour.

812. On range boards issued prior to December 26, 1906, the curves are constructed to give the corrections for the *actual* range. Therefore it is necessary that the operator of the board should keep the ruler set at the *actual* range and not at the *corrected* range. A setting to within 100 yards of the actual range is sufficiently accurate. The operator should be

drilled in obtaining approximately the actual ranges from the corrected ranges read by the plotter from the gun arm of the plotting board.

813. On range boards issued December 26, 1906, and subsequently, the curves are constructed to give the corrections for the *corrected* range, so that the ranges read from the gun arm of the plotting board should be used in setting the ruler. The first corrected range can be obtained only by using the actual range for setting the ruler, hence it is only an approximation. The *second corrected range* obtained by setting the ruler at the first corrected range will be sufficiently accurate to use for firing. *It is necessary to obtain the second corrected range in firing at a stationary target as well as at a moving target.*

Probable muzzle velocity.

814. In determining the data for trial shots some velocity must be assumed; it may or may not be the normal velocity, depending upon the circumstances, such as the temperature of the powder, or some assumed deterioration of the powder based upon previous experience with the same lot. The velocity marker is set for this assumed velocity, the other markers to the proper curves for the conditions of the day and the proper range corrections obtained as described above. If the center of impact of the trial shots fired with this velocity is short of or beyond the expected range, the error may be considered as due to an erroneous assumed velocity and the center of impact may be brought to the expected range by using a new velocity determined as shown by the following examples:

Suppose—

1. The actual range to the target to be 7,100 yards.
2. The range at which the gun was laid to be 7,450 yards.
3. The range to the splash 7,200 yards (to center of impact where using data from more than one shot).

Then (with range boards issued prior to December 26, 1906)—

1. Set the ruler at the range to the splash, 7,200.
2. Set the index at 2,100, corresponding to the actual range of the target.
3. Set the pointer to the velocity assumed for the trial shots.
4. Slide the bar until the index reads 2,200.

Then the pointer indicates the probable velocity.

The result should be verified, as follows:

Conceive the target to be moved to 7,200 yards so that the splash (or center of impact) and the target coincide. Using the muzzle velocity as determined above and the atmospheric data for the day, determine the corrected range. This should be 7,450.

With range boards issued December 26, 1906, and subsequently, the method is the same as the above, except that the

ruler should be set at the range for which the gun is laid (corrected range), viz, 7,450. In checking the results on these boards the second corrected range obtained should be the same as the corrected range for the trial shots.

Additional examples taken from actual practice:

10-inch rifle (range board issued prior to December 26, 1906).

Powder C. P. W., lot 5, 1901; M. V.=2,235 f. s.

Temperature of testing, 70° F.

Temperature of magazine at time of firing, 65° F.

Temperature correction reduces initial velocity to 2,225 f. s.

Corrections due to atmosphere, wind, tide, and velocity aggregate +130 yards.

The actual range to the target was 6,410 yards (the corrected range set off on range drum of gun was 6,410+130 yards=6,540 yards).

The range to the splash was 6,100 yards (the center of impact of the three trial shots was 310 yards short).

(a) The ruler was set at the range to the splash, 6,100 yards.

(b) The index was set at 2,410 corresponding to the actual range to the target.

(c) The velocity marker was set at the velocity assumed for the trial shots (2,225 f. s.).

(d) The bar was moved to the left until the index read 2,100. Then the pointer indicated a velocity of 2,163 f. s.

10-inch rifle (range board issued prior to December 26, 1906).

Powder C. P. W., lot 5, 1901; M. V.=2,235 f. s.

Temperature of testing, 70° F.

Temperature of magazine at time of firing, 70° F.

No powder correction for temperature.

In the previous firing with this lot of powder the corrected velocity was found to be 2,163 f. s.

Corrections due to atmosphere, wind, and tide aggregated +50 yards.

The results of the trial shots were as follows:

First trial shot	--	51 yards.
Second trial shot	--	27 yards.
Third trial shot	--	50 yards.

3) — 128

Average --- — 42 yards.

The velocity for the records was determined as follows:

(a) The ruler was set at the range of the center of impact of the trial shots (6,548 yards).

(b) The index was set at 2,590 (corresponding to the actual range to the target).

(c) The velocity marker was set at the velocity assumed for trial shots (2,163 f. s.).

(d) The bar was moved to the left until the index read 2,548. Then the pointer indicated the probable velocity for the record shots, viz, 2,150 f. s.

815. If for any reason it is impossible to obtain any data as to atmospheric conditions, all corrections may be thrown into the velocity correction by assuming a velocity, firing trial shots, and determining a new velocity, as above; it is desirable for the assumed velocity to be as near the correct velocity as possible.

Searchlights.

816. See Artillery Notes, No. 31.

Telautograph.

817. See Signal Corps Manual, No. 8.

Telephone.

818. See Signal Corps Manual, No. 8.

TELESCOPE.

819. Figure 9 illustrates the important parts of a telescope.

A telescope is a delicate piece of apparatus and requires careful use. It should never be subjected to unnecessary shock. When not in use it should be kept in the case provided for it or protected by proper covers. Parts liable to rust should be kept lightly oiled; bronze parts should be kept clean and dry. To obtain satisfactory vision absolute cleanliness of the lenses is necessary, and they must be kept free from moisture. Cham-
mois skin or a clean linen handkerchief may be used to remove moisture or particles of dust, care being taken that the lens is not scratched by grit or dirt. The lenses will require cleaning on the inside infrequently, and when this is necessary they should be removed by a competent person. The object glass must be kept screwed home at all times. Erecting prisms, if found in the telescope, should never be removed from the prism holder, nor the objective lenses from the objective cell and ring. If they need repair, report should be made to the proper authority. When the eyepiece of a telescope is removed the cross wires are generally exposed in the tube. They are very delicate and must not be touched.

820. In the use of a telescope for coast artillery purposes two adjustments are necessary:

1. The focusing of the eyepiece so that the cross wires appear clear and distinct: This should be done by pointing the telescope to the sky. It should not be done with any near object in the field of view. Generally the cross wires have

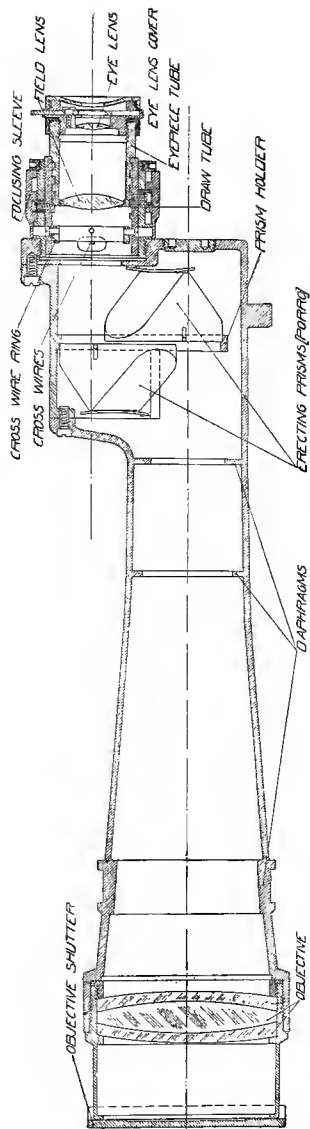


Fig. 9.

more or less roughness on them, which is most clearly seen when the eyepiece is focused properly. Another way of testing this adjustment is to see whether or not the ends of either cross wire appear double or blurred. If so, the adjustment is not perfect.

2. The focusing of the objective so that the object appears clear and distinct: The proper position of the objective to obtain this result will be found most readily by moving it in and out a few times past the proper point. When the image appears to be satisfactory as to clearness the head should be moved from side to side or up and down as far as possible, keeping the image still in view. If the intersection of the cross wires appears to remain upon exactly the same point on the object, the focusing is satisfactory; otherwise not. The adjustment should be repeated until this result is obtained. Apparent motion of the cross wires on the image, due to faulty focusing of the object glass, is spoken of frequently as "parallax." The parallax must be eliminated before satisfactory work can be accomplished.

TELESCOPIC SIGHT.

821. The telescopic sight is attached to the gun carriage, so that its axis may be adjusted to intersect the axis of the gun at or beyond mid-range. Normally it is used to give direction to the gun, the deflection being set on the sight by means of a horizontal scale graduated from 0° to 6° —the 3° point being in the vertical plane containing the axis of the telescope. On some carriages the sight is mounted so that it may be used to give elevation as well as direction.

THERMOMETER.

822. In locating the thermometer in or near the meteorological station the following should be borne in mind:

First. The temperature of the outside air is required and not the temperature of the station.

Second. The thermometer must be in the shade to obtain the temperature of the air.

Third. The thermometer should not be located where it can be affected by radiation from the walls of the station or by artificial heat from any source.

Fourth. The thermometer should be placed where it is exposed to a fair circulation of air and protected from the sun and rain.

Great accuracy in the determination of atmospheric data is not necessary. Temperature is the most important; a change of 5° has about the same effect upon the range as a 10-mile longitudinal wind; five-tenths of an inch is a corresponding barometric change.

Time-interval system.

823. See Signal Corps Manual No. 8.

WIND COMPONENT INDICATOR.

824. The object of this device is to determine the wind reference numbers to be used on the range and deflection boards and to indicate the numbers to the operators of these boards.

It consists of a circular dial (*a*), figure 10, on the face of which the reference numbers are marked with corresponding horizontal and vertical lines. The dial is intended to be held in a vertical position by means of a bracket (*m*) screwed to the wall and fastened to the back of the dial in such a way that the dial itself will not turn; hence the figures it carries will be right side up always.

825. Around the dial is the movable azimuth ring (*b*), graduated and numbered clockwise every 5 degrees. This ring can be set so that the wind azimuth pointer (*k*) at the bottom of the dial points to any required wind azimuth. The ring can be clamped in position by a clamp screw at the back of the plate immediately behind the wind azimuth index.

826. Embracing both dial and ring and rotating about an axle at the back of the dial is the target arm (*C'*). The target arm is centered in front by the screw (*d*), which passes through the end of it into the center of the dial. It has a clamp screw, by means of which it may be clamped at any desired azimuth, indicated by the azimuth index (*c*).

827. The pointer (*HH'*) passes through a slot in the square projection on the end of the target arm and can be set to indicate any wind velocity from 0 to 50 miles per hour by means of the wind scale on the target arm, using the end *H* of the pointer as an index. The reference numbers to be used on the range and deflection boards are indicated by the end (*H'*) of the pointer. The instrument is intended to be suspended from the ceiling immediately over the plotting board and facing the range and deflection boards, so that the operators of these boards can read the range and deflection components without leaving their positions.

828. The operator sets the pointer (*H*) to the wind velocity, and by turning the azimuth ring brings the wind azimuth to the pointer (*K*). He keeps the target arm set to the approximate azimuth to the target, as indicated by the gun arm, using the index (*C*) and moving the target arm as the target moves. Should the wind change in velocity or direction, he makes the corresponding change on the board.

WIND VANE.

829. This is a device for determining the direction of the wind. It should be remembered that the mean direction of the wind is desired. The ordinary fluctuations in direction are

WIND COMPONENT INDICATOR.

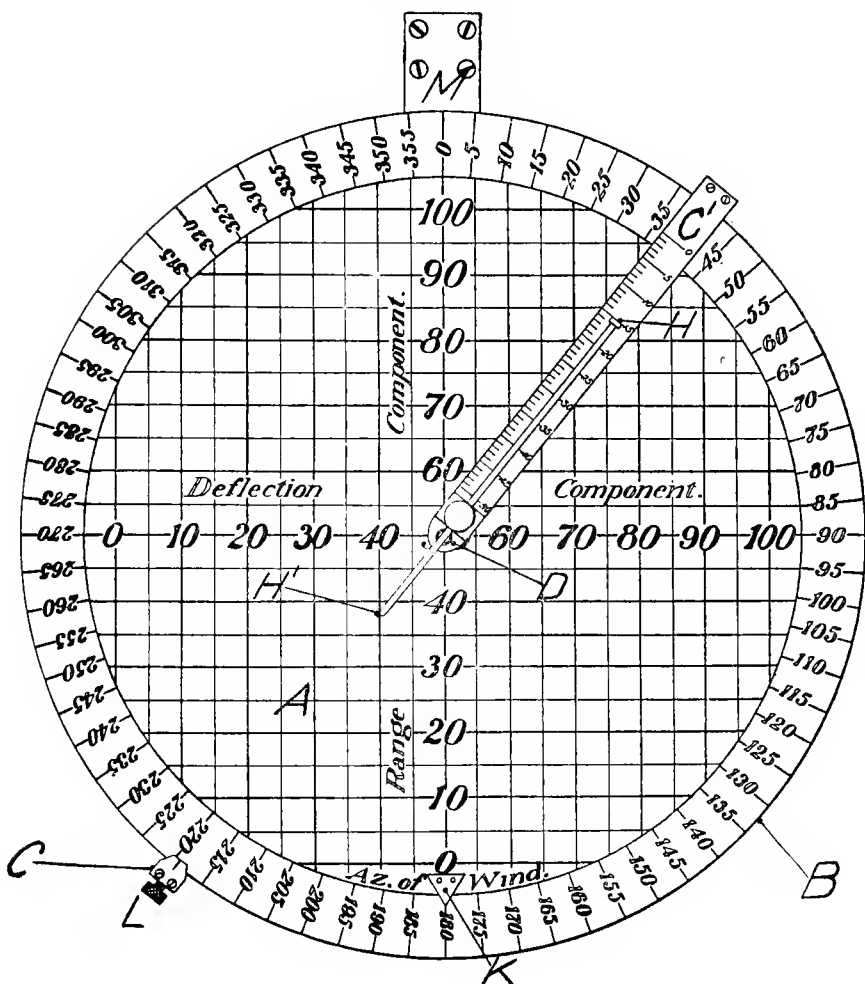


Fig. 10.

due usually to local causes near the surface of the earth and have but little effect upon the flight of the projectile. A true fish-tail wind undoubtedly produces varying results, but it is not practicable to do anything other than consider its mean direction. The observer should watch carefully the movement of the vane and endeavor to obtain the true mean. It will be found useful to make chalk marks indicating the observed swing of the vane, by means of which the mean direction can be determined.

CHAPTER XVIII.

CARE OF MATERIAL.

GENERAL INSTRUCTIONS.

830. Officers are held to a strict responsibility for the proper care and preservation of all artillery material in their charge.

831. The methods prescribed for care and preservation of material are those described herein and those contained in the publications issued by the supply departments.

832. Batteries are "in service" when they are used at daily drill by coast-artillery manning parties. Batteries are "out of service" when they are in the hands of a coast-artillery manning party but not used at daily drill. A battery is "out of commission" when it is not in the hands of a coast-artillery manning party. Batteries "in service" or "out of service" are "in commission."

833. Battery commanders are responsible for the ordnance property pertaining to batteries "in commission," and ordnance officers for those "out of commission."

834. All disappearing guns in commission shall be tripped at least once each week. All guns in commission shall be elevated and depressed between limits at least once each week. All carriages in commission shall be traversed between stops once each week. Guns and carriages out of commission shall be tripped, elevated, depressed, and traversed at least once each month.

835. The ammunition-service apparatus (trolleys, motors, and hoists) shall be operated at least once each week, and the different working parts (pulleys, journals, etc.) should be kept clean and lubricated. Special care must be exercised in operating the motor starter and in preventing the jamming of any part of the hoists; also in the handling of projectiles at the receiving and delivery tables. The Hodges ammunition hoist is not designed and must not be used for lowering projectiles, either by motor or by hand power. The Taylor-Raymond ammunition hoist may be used with safety to lower projectiles by hand power, provided care be exercised and the hoist operated slowly; but the hoist must not be used to lower projectiles by motor power. Where emplacements are provided with cranes these should be used in preference to the Taylor-Raymond hoist for lowering projectiles.

836. For care of hoists, see Engineer Mimeograph, No. 46, and supplements.

Fortifications in general.

837. The Engineer Department erects, alters, and maintains all batteries, fire-control stations, fortification power plants, and structures used for submarine mining.

838. The Engineer Department supplies, installs, and maintains the following:

Apparatus and lines for fortification power and lighting (except signal corps storage batteries and mechanisms for operating fire-control apparatus, mining casemate equipment for operating the mine system, and ordnance motors for operating guns); cable approaches and covers for cable terminals; ammunition hoists; trolleys; pulleys; searchlights and their equipment.

It supplies the following:

Circular benches for observing instruments and plotting boards; rubber floor cloth for the floors of stations, telephone booths, and dynamo rooms, reserve lanterns.

It installs underground communication lines.

It furnishes the supplies given in the following table:

Supplies.	Use.
Paints.....	For emplacements, steel and iron work, boilers and engines, and electrical apparatus pertaining to seacoast batteries.
Spare parts for engines, boilers, heaters, generators, etc.	For power plants maintained by Engineer Department.

839. The Ordnance Department supplies and maintains the following:

Guns and mortars and their carriages and accessories; tools and implements for the service thereof; also fire-control apparatus (not pertaining to communications, time-interval system, signaling and meteorological data), and in addition observation telescopes; stop watches; cameras and camera supplies; drawing boards and drawing instruments; thermometers and hygrometers; magnetos for firing; firing batteries; bench and hand tools and appliances for fortification power plants and ordnance repair shops, stencils, and figures for marking guns and emplacements.

It installs motors on the gun carriages, their circuits, wiring for firing circuits and illuminating circuits on carriages, and position-finding instruments.

It furnishes the supplies given in the following table :

Supplies.	Use.
Paints.....	For guns, carriages, and position-finding instruments.
Oils for paint.....	Do.
Lubricating oils.....	Do.
Neutral oil.....	For recoil cylinders, gun carriages.
Slushing oil.....	For guns and carriages.
Kerosene.....	For cleaning recoil cylinders and guns.
Abrasives.....	For removing old paint from the guns, carriages, sights, position finders.
Paulins.....	For gun covers.
Rope, blocks, gins, etc.....	For mechanical maneuvers.
Draftsman's supplies.....	For battery charts.
<i>Miscellaneous.</i>	
Cleaning material: Sal soda, quicklime, powdered lye, chamois skins, burlap, flax, twine, packing needles, putty, cotton waste (white), cotton waste (cob), lumber, nails, screws, paint pots, sieves, brushes, corn brooms, whisk brooms, hand sponges.	For cleaning, painting, and packing guns and carriages, and position finders, etc.
Oil storage tanks (30 and 60 gallons), funnels, and measures.	For storage of oil at batteries.
Plumbers' force pumps.....	For cleaning recoil cylinders.
Hose.....	For policing magazines, guns, and carriages.

840. For detailed information in regard to allowance of materials enumerated above, see Ordnance Pamphlet 1869.

841. The Signal Corps supplies, installs, and maintains the following :

All fire-control apparatus pertaining to communications, time-interval system, signaling, and meteorological data.

It supplies field glasses, portable ammeters and voltmeters; all cable for communications.

It installs submarine cables, overhead lines, and inside wiring, pertaining to the apparatus furnished by it.

842. The Quartermaster's Department supplies the following :

Furniture (not including rubber floor cloth or circular benches for fire-control stations), stoves, scythes, sickles, shovels, rakes, fuel-handling apparatus, fire tools, wheelbarrows, etc.

It furnishes the supplies given in the following table :

Supplies.	Use.
Paints.....	For power and electric plants.
Fuel.....	Do.
Lubricating oil, kerosene.....	Do.
Storage tanks, oil.....	Do.
Brooms, sapolio, brushes, soap, mops, soda, waste.	For police of fire-control stations, power and electric plants.
Spare parts for engines, generators, boilers, and accessories.	For power plants maintained by the Quartermaster's Department.

843. Platforms, parapets, and the grounds surrounding them, whose limits are prescribed by post commanders, shall be kept in proper police. Drains and sumps shall be inspected weekly and kept in order.

844. Any damage to or defects in the engineer, signal, or ordnance work or property shall be reported promptly to the proper authority.

845. Gun commanders are charged with the care of the guns, carriages, and loading platforms at all times.

846. Parts of seacoast guns and carriages are not expendable, and irrespective of their condition are borne on property returns.

847. Pamphlets and publications descriptive of ordnance material and containing instructions relative to caring for, mounting, and using guns, mortars, and accessories are issued by the Ordnance Department as listed in Ordnance Department Pamphlet No. 1467.

848. Oils (see Ordnance Pamphlet No. 1869).—The important oils supplied and uses therefor are shown in the following table :

No.	Name.	Use.
1	Hydrolene.....	To fill recoil cylinders.
2	Kerosene.....	For cleaning purposes, especially recoil cylinders.
3	Light slushing.....	For bore, bright parts of guns and carriages out of commission.
4	One-third light slushing, two-thirds synovial.	All bright parts of guns of carriages out of service, bores of guns in and out of service.
5	Synovial.....	For bright parts of guns and carriages in service. For lubricating purposes where oil holes or plugs are provided.
6	No. 4½.....	To fill grease cups.
7	Turpentine.....	For mixing paint.

Oils should be kept in closed receptacles, free from contamination, and not be used a second time unless strained carefully. Discoloration does not in itself affect the serviceability of oils.

849. Care must be exercised that no water is allowed to enter the recoil cylinders when they are filled with oil or at any other time, for this will cause rusting of the interior of the cylinders.

In cold weather it may freeze and burst the equalizing pipes or other parts of the recoil system.

850. Painting.—For allowances and preparation of paints, see Ordnance Pamphlet 1869.

851. Guns and mortars.—In general, three coats of paint are given guns and mortars the first year that they are mounted; thereafter two coats annually will suffice, the actual needs depending upon the climate and local conditions.

As soon as the piece is mounted on its carriage, all parts which have been marred in transportation are primed, after which one complete coat of the gray paint is applied.

The entire surfaces of guns and mortars, except the portions where the tray bears, are painted gray. When detached quadrants are used with mortars the seats for the quadrants are left unpainted. Before painting the surfaces are rubbed smooth and made perfectly clean and dry. Special care must be exercised to prevent painting contact surfaces forming part of an electrical circuit.

Bronze trays are not painted. Steel trays, excepting the upper and front surfaces and guide rails are painted the same color as the gun. No parts of the breechblock or mechanism are painted. The unpainted surfaces must be kept clean and bright with oil or pomade.

The elevating bands of pieces mounted on disappearing carriages and the elevating racks attached to pieces mounted on mortar and barbette carriages are painted the same color as the guns or mortars, leaving the bearing surfaces of the teeth unpainted.

852. Carriages.—The number of coats of paint required for carriages is the same as that for guns and mortars. Before painting, surfaces should be rubbed smooth and made perfectly clean and dry. As soon as the carriage is assembled completely and the piece mounted, all parts which have been marred in transportation are primed, after which one complete coat of olive paint is applied.

All steel and iron nonbearing surfaces, both inside and out, are painted. This includes the exposed parts of shafts (except squared ends), bottom plate of counterweight, ladders, crossheads, cranks (not handles), crosshead pawls (except teeth), and large bronze pieces, including web and spokes of wheels and cylinder heads.

The following parts are not painted: All wearing or bearing surfaces, which include the handles of handwheels and cranks, teeth of all gear wheels, teeth of crosshead pawls, teeth of crossheads, elevating-rack guides, rollers and surfaces on which they travel, piston rods, crosshead guides, etc.

The bronze sight holders are not painted, nor are the azimuth and elevation scales and pointers and the followers of

the stuffing boxes; these parts, with the exception of the sight holders, must be kept clean and bright with oil or pomade.

Name and direction plates and trunnion brackets for telescopic sights shall not be removed while painting guns and carriages. Sight brackets shall not be painted. Name and direction plates are painted, but the raised surfaces of the letters and figures must be kept polished.

853. The paints mentioned are supplied in original packages, mixed ready for use. In all cases before using the contents of the package should be stirred thoroughly with a wooden paddle; if thinning is desired, turpentine is used. Care should be exercised to have the paint of the proper consistency before it is applied.

854. To remove old paint from guns and carriages.—When the paint becomes so thick as to scale off in places or to give an unsightly appearance, as is the case after a number of coats have been applied to guns and carriages, it is removed for repainting as follows:

Dissolve 1 pound of concentrated lye, powdered form, in 6 pints of hot water and add enough slaked lime to give the solution the consistency of paint. Use the solution, freshly mixed, and apply to the parts where paint is to be removed with a brush or with waste tied on the end of a stick. When the solution begins to dry on the surface use a scraper to remove the old paint and complete the cleaning of the surface with a mop and water. If one application is not sufficient to loosen the paint, apply a second coat. Before applying a new coat of paint wash the surface with a liquid made by dissolving one-half pound of washing soda in 8 quarts of water and wipe dry. Let stand a sufficient length of time so that all parts will be thoroughly dry before painting.

855. Marking guns, mortars, and mortar pits.—At all coast artillery posts the position of every gun, mounted or to be mounted, is given a number. When the gun is in position this number is placed on it.

Guns and mortars arranged in line are numbered from right to left in separate series for each battery.

The two pits of each mortar battery are lettered from right to left or from rear to front *A* and *B*. The mortars in each pit are numbered as follows:

- No. 1. The right rear mortar.
- No. 2. The right front mortar.
- No. 3. The left rear mortar.
- No. 4. The left front mortar.

The mortar-pit letter is painted with its median line on the median line of the front vertical wall or interior slope of the pit and with its middle point about 10 feet above the floor. The letter is block, 10 inches high and 8 inches wide, and painted in white on circular black background 16 inches in diameter. The mortar number is painted with its median line on the upper element of the mortar, half way between the

median circular element of the trunnion band and the face of the breech, the top of the figure being toward the trunnion band. The number is white block, 4 inches high.

The tactical numbers of guns of 8 inches caliber and upward are painted on the left half of the horizontal diameter of the face of the breech, half way between the circumference of the opening of the breech recess and the circumference of the face of the breech. The numbers are white block, 4 inches high.

The tactical numbers of guns of caliber less than 8 inches are located on the gun or carriage so as to be visible easily from the rear, the location on each class of gun and carriage in an artillery district being uniform and as prescribed by the district commander. The numbers are white block, $1\frac{1}{2}$ inches high.

856. Care of guns and mortars.—No part of the piece should be allowed to rust at any time, and if it is to remain unused for short intervals all bright and bearing parts should be covered with a coat of two-thirds synovial and one-third light slushing oil. If the piece is to remain unused for a long interval, light slushing oil should be used. For the bore two applications per year are considered sufficient; for surfaces exposed to the weather four applications may be required.

857. To oil the bore an ordinary counter brush is used; it is secured to the end of a rod and provided with a half disk of wood to keep it against the bore. By this means any required thickness may be applied. The brush rod for guns is fitted with a socket for connecting it with the special sponge staff. For mortars the brush is supplied with a special handle.

858. To remove the greater portion of the slushing oil from the bore an iron scraper is used. For guns it is fitted for attachment to the staff of the special sponge; for mortars it is provided with a shaft 14 feet in length. The entire removal of the oil and residue from the bore by hand is necessary for star gauging, firing, and after firing before oiling the bore. After the greater portion of the slushing oil is removed with the scraper, a sponge is dipped in a solution of concentrated lye and passed through the bore. This softens and dissolves partially the coating. Then burlap is wrapped around the special solid-head sponge, the whole being made of such diameter that it requires eight or ten men to pass it through the bore, since considerable pressure against the bore is necessary in order to reach the bottom of the grooves. For covering the sponge the burlap is cut from 4 to 8 inches longer than the head and the selvaige laced together with packing needle and twine. The bore is wiped perfectly dry before firing.

859. After firing the powder residue is removed by using either the sponges or special cleaning sponge well saturated with water. To effect this completely burlap is used, one or two thicknesses being secured over the head of the sponge.

860. The habitual position of guns on disappearing carriages is in the loading position, i. e., at an elevation of 5° . Guns on barbette carriages are given the same elevation.

861. Mortars are elevated habitually so that their axes will be parallel to the piston rod. The breech cover is left off and the translating roller is left in place. At posts where the sand blows into the breech mechanism and at all posts during the cold season where snow and ice may collect and form around the breech mechanism the mortar is kept horizontal with the breech cover on.

862. Care of carriages.—When in use all bearing parts must be cleaned and lubricated thoroughly. In all carriages special attention should be given to the lubrication of gun trunnions, rollers, pintle surfaces, sliding surfaces, elevating, loading, and traversing mechanisms, including the teeth of all gears. On disappearing carriages the following parts must be lubricated also: Gun-lever axle bearings, crosshead pins, tripping and retracting mechanisms, elevating rack and band trunnions, and crosshead guides.

The parts mentioned above should be lubricated frequently whether the carriages are in use or not.

Oil holes where provided must be cleaned out frequently to keep them free from sand and grit, and kept closed habitually by the screw plugs or covers provided except during oiling.

Before oiling at any oil hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.

Compression grease cups are filled with No. 4½ lubricant, so as to show at all times the plunger well above the top of the cup.

In general, no parts should be allowed at any time to rust, and if a carriage is to remain unused for a short interval all bright and bearing parts should be covered with a thin coat of one-third light slushing oil and two-thirds synovial oil. If the carriages are to remain unused for a long interval, slushing oil should be used. The rollers and roller paths should be cleaned and covered with the above mixture and the space between dust guards and base rings filled with waste or oakum to keep out dust. Any wrench holes inside of the base rings should be plugged tightly with fitted wooden plugs.

Experience has indicated that the oil should not be removed from recoil cylinders when carriages are to remain unused for a considerable period, as the walls of the cylinders soon become dry and rust.

Garlock's waterproof hydraulic packing is furnished for packing all stuffing boxes of gun carriages, but hemp packing may be used when necessary.

If rust is allowed to accumulate on carriages, its removal from all bearing parts, and especially piston rods, requires particular attention in order that clearances shall not be increased unduly. The use of sandpaper for this purpose is forbidden, and emery cloth No. 1 is coarse enough for removal of ordinary rust, the rust being softened, if necessary, by kerosene.

On all seacoast gun carriages special care must be exercised to insure that bolts passing into hydraulic cylinders are tight at all times.

863. Mortars are raised from their trunnion beds at least once every two years, or more frequently if necessary, and trunnion beds cleaned thoroughly, including the oil grooves in the trunnion-bed liners.

864. Once every two years mortars shall be dismantled, the carriage cleaned and overhauled, and the old paint removed from the counter-recoil springs, which are given two coats of new paint. The springs must not be reassembled until the paint is dry. The springs on the right spring bolt are placed on the left spring bolt and the springs on the two inside bolts interchanged in reassembling.

865. A record of the dismantling and cleaning is kept in the emplacement book.

866. To dismount mortars for cleaning springs.—Take off the guides and guide caps and unscrew the piston-rod nuts; use a prop under the lower end of each of the cylinders to hold them steady as the mortar is raised.

If the springs continue to raise the mortar as the piston-rod nuts are unscrewed a tackle should be used to hold the mortar down to the racer. This should be slacked off carefully as the nuts are unscrewed, so as to prevent any destructive strains on the nuts.

Build cribbing on both sides of the breech and at the muzzle. Place a 12-inch block, hewn round, in the muzzle and a 12-inch skid, 12 or 15 feet long, under the breech (the span to be not greater than 9 feet). Have the face of the skid flush with the face of the breech and the left half moved well forward, otherwise the skid will not clear the pedestal bracket as the mortar is raised. Place props in the well for the cylinders.

Raise the mortar by jacks (15-ton jacks are preferable), one under each end of the skid and one at the muzzle. The blocking should be placed under the skid and under the muzzle. As the three jacks go up together the saddle rotates about the fulcrum and the mortar is moved gradually to the front; the cribbing should be arranged accordingly. Much time will be saved if the jacks are canted about 25° from the vertical when they take hold, as they will have a longer arc to work through. Before going up on the jacks unclamp the elevating gear. When the crossheads leave the piston rods move the props so that the cylinders will rotate about their trunnions, top end toward the rear; this gives more room for the cribbing.

When the centers of the trunnions are about 5 feet 9 inches above the racer the springs are fully extended and the spring cap can be taken out. Then the spring columns can be collapsed toward the middle. With the aid of a rope around the five columns they can be pulled to a vertical position, where each spring, washer, and rod can be removed.

867. In assembling the springs follow the same method in reverse order. Before placing the springs and washers on the

spring rods run down the locking nuts against the fixed nuts. This will bring the top of the spring rods nearer the spring cap and cause them to enter more freely. The spring rods will have to be guided into their proper holes in the spring cap. This is done by letting the spring columns rest against a small scantling. After the saddle has been lowered a few inches and some compression given the springs the spring rods can be guided accurately into their proper holes with the aid of a crowbar. A small amount of oil on the top end of each spring rod will assist the rods materially in sliding through the spring cap.

Should the weight of the mortar fail to compress the springs sufficiently to permit the entering of the piston-rod nuts, the assembling bolts and compression washers, or the tackle above referred to, can be used to draw the mortar down. The weight of 10 men standing on the mortar will lower it about half an inch.

After the guides, etc., have been assembled the assembling bolts and compression washers can be used to hold the saddle while the gun is raised 5 or 6 inches out of the trunnion beds for the purpose of cleaning the trunnions and their beds.

868. Removal of paint from counter-recoil springs.—The following method is used when practicable:

For 100 counter-recoil springs, dissolve 15 pounds of lye in water, using an iron kettle or trough sufficiently large to permit of complete immersion of as many springs as possible. Heat the solution to the boiling point and immerse each spring for about five minutes. Upon removing the spring from the solution the old paint may be washed off by a stream of water from a hose.

869. Cleaning of recoil cylinders.—Recoil cylinders should be cleaned a short time prior to each firing.

In no case is it necessary to remove the packing from stuffing boxes in order to clean the cylinders.

The following methods are given as guides:

First method (disappearing carriages).

(a) Trip the gun.

(b) Remove the oil from the hydraulic recoil system as follows:

Obtain a length of hose sufficiently long to reach from the emptying coupling to the gun platform, make one end fast to the equalizing pipe under the emptying coupling, and place a funnel in the end so that when the coupling is opened oil will flow into the funnel and through the hose. Provide a reserve tank for hydrolene oil and place it on the gun platform near the chassis. Pass the end of the hose through the opening in the chassis just in front of the traversing shaft, place a sieve above the opening in the top of the reserve tank and hold the end of the hose just above the sieve. Unscrew the opening coupling and the oil will flow from the cylinders (both filling

plugs having been taken out) into the reserve tank. This avoids spilling oil on the carriage and the platform and saves the labor of handling it in buckets.

(c) Retract the gun until the pistons are in the middle of the cylinders, then slack away until the pawls engage in the ratchet teeth on the crosshead; observe that the pawls are engaged properly in the ratchet teeth, and that the pistons are not under the filling holes.

(d) Remove the piston-rod brackets from the rear ends of the chassis rails. Take off the two nuts on the front end of each piston rod, remove the rear cylinder head from each cylinder, and pull the rods carefully to the rear out of the cylinders. Before removing any part it should be marked so as to insure its being assembled in its correct position.

(e) Clean thoroughly each cylinder from both ends with kerosene oil forced in with a hand pump, then wipe dry with clean cotton waste and clean the piston rods. The equalizing and connecting pipes should be dismounted and cleaned by forcing kerosene oil into them with the pump.

(f) Assemble the equalizing and connecting pipes, leaving the throttling valve wide open. Insert each piston rod in its cylinder, exercising care to prevent binding of the piston, burring of the walls, or other damage. Assemble the two nuts on the front of the rod; move each rear cylinder head forward into its seat in the cylinder. Assemble the piston-rod brackets to the chassis, and then secure firmly the rear cylinder heads to the cylinders and fill the recoil cylinders with hydrolene oil. This will require some time, as the oil can enter the parts of the cylinders in rear of the pistons only through the equalizing pipes and the throttling bar orifices. Insert the filling plugs when apparently filled, close the throttling valve, and retract the gun to the loading position. Complete the filling of the cylinders and close the throttling valve to its proper setting.

For this method a plumber's forcepump is supplied to each coast artillery post, also suction-hose discharge tube.

Inspect carefully all parts dismounted and note that they have been assembled properly; then trip the pawls and let the gun rise into battery. Then the piston-rod nuts should be loosened to insure the rod being located centrally in the cylinder and the nuts tightened.

The gun should be retracted and tripped several times to insure that all parts are in proper working order.

Second method (disappearing carriage).

(a) Trip the gun.

(b) Remove the oil.

(c) Close the emptying coupling and put 10 gallons of kerosene oil in each cylinder and replace filling plugs. With the use of retraction cables bring the gun from battery and allow it to go in battery slowly with the cables on, controlling the motion by the retraction cranks. Repeat this operation

several times. In this way the kerosene will be forced through every portion of the recoil cylinders and pipes and will clean all parts. With the gun in battery the emptying coupling is unscrewed and the kerosene allowed to drain out. After kerosene has drained out place about 20 gallons of hydrolene in the cylinders and work the gun in and from battery with cables on, in the same manner as before. Drain this hydrolene out and throw it away or save it to flush out pintle bearings. After cylinders have drained refill with hydrolene.

When batteries are equipped with electric power for retracting, the foregoing method is an easy one. Guns are drawn from battery by power and allowed to go back with four men on the retracting cranks (for 12-inch guns). If retracting is to be done by hand, labor will be saved by removing all hand counterweights before starting.

(d) If cylinders have not been cleaned for so long that female portions of counter-recoil buffers have become packed with hardened oil and sediment, the gun will either go in battery by creeping the last inch or may not go entirely in. If the above method does not serve to remove the obstruction, the cylinder head must be taken out and the buffers cleaned by hand.

(e) In employing this method a careful examination should be made to see that the cables are in good condition, and the gun must be allowed to go into battery slowly and evenly.

Third method (barbette carriage).

(a) Remove oil from cylinders and equalizing pipes.

(b) Retract the gun until the pistons are in the middle of the cylinders; place hard-wood planks, 1 inch thick, between the front ends of the cylinders and the counter-recoil stops so as to retain the top carriage positively in this position. Care should be taken that both planks are of equal length.

(c) Remove the cylinder heads and both piston-rod nuts and withdraw the piston rods carefully from the cylinders. Each part dismantled should be tagged to insure its being assembled in its correct place.

(d) Clean the cylinders thoroughly with kerosene oil forced from a hand pump into both ends of each cylinder. The plug in the emptying coupling should be removed and both branches of the equalizing pipe flushed out from their cylinder ends. (In 10-inch barbette carriages, model of 1893, Nos. 2 to 10, inclusive, a cored equalizing passage connects the pressure ends of the cylinders. In these carriages the emptying plug at the middle of this passage should be removed and both parts of the passage flushed out, as in the case of the equalizing pipe.) Then wipe the interior of the cylinders dry with clean cotton waste and clean the piston rods and cylinder heads.

(c) Replace the emptying coupling plug, assemble the piston-rod nuts and cylinder heads, exercising great care that none of the parts are burred or otherwise damaged. The cylinder heads should be screwed into place firmly, care being taken that the packing ring is in good condition and placed properly. Screw the followers tight against the packing in the stuffing boxes.

All parts dismantled should be inspected to ascertain that they have been assembled properly. Retract the top carriage until both planks can be removed, then, by means of the retracting gear, allow the gun to return slowly into the firing position. After the cylinders have been filled with oil the gun should be retracted and allowed to run into battery several times to insure that all parts are in good working order.

Fourth method (pedestal mount).

For this method the following material is required:

Three 12 by 12 inch blocks.

Two 12 by 6 inch blocks.

Two 12 by 4 inch blocks.

Six 12 by 2 inch blocks.

Four 12 by 1 inch blocks.

The above blocks should be about 3 feet 6 inches long.

One 15-ton jack.

Sixty feet 2-inch rope.

Sixty feet 3-inch rope.

Two single blocks.

Two double blocks.

One 24-inch rule.

One chain pipe wrench.

One sledge hammer.

Five gallons kerosene oil.

Ten pounds waste.

One pound white lead.

The necessary tools in tool chest provided with gun and carriage.

The recoil cylinders of these carriages should be emptied at least once in three months and cleaned thoroughly at least once in six months. A plumber's hand force pump is used for this purpose.

The method is as follows:

(a) Elevate the gun about 10° and remove the oil in the recoil cylinder through the drain hole.

(b) Place the gun at 5° depression; measure accurately the distance from the front face of the piston-rod lug on the band to the rear end of the recoil cylinder, for use in assembling the gun correctly in its balanced position. Knot a stout cable tightly around the breech of the gun immediately in rear of the band, passing the end along the top of the gun and through the eyebolt on top of the cradle. Lash it to one of the shield supports, leaving as little slack in the cable as possible.

Unscrew slowly the rear nut on each spring rod until the front nut bears against the spring cylinder head, then remove the rear nuts. Remove the rear nut on the recoil piston rod and the spring yoke. Build up blocks of various thicknesses under the breech of the gun so that when the piece is set at 5° elevation there is a clearance of about 1 inch between the upper surface of the topmost block and the lug of the recoil band. This is recommended as a safety precaution.

Place the gun at 5° elevation, slack the cable, and push the gun rearward. If it is impossible to start the gun in this way, attach a luff tackle, and if six or eight men are unable to start it with this, tap the face of the muzzle with a heavy block, keeping a steady strain on the fall of the tackle. Repeat these operations until the distance from the front face of the piston-rod lug to the rear end of the piston is just sufficient to permit the front nut to be removed. As the piece slides back keep a clearance of about 1-inch under the recoil lug, shifting the blocks for this purpose. Remove the bolt which secures the left-hand spring-case extension to the cradle, unscrew the spring-case extension (using a chain-pipe wrench), and remove it with the recoil springs still assembled. This will permit ready access to the cylinder head. Unscrew the follower about three turns to relieve the pressure on the packing and unscrew the cylinder head. It may be necessary to start the cylinder head by a blow on the handle of the cylinder-head wrench with a sledge hammer. Move the piston rod rearward through its hole in the recoil lug until the piston and rear cylinder head are against the lug.

(c) Clean thoroughly the cylinder with kerosene oil forced into the rear end with a hand pump or by hand with waste soaked in kerosene oil, then wipe the interior dry with clean cotton waste. Then the piston rod, piston, and rear cylinder head should be cleaned. The counter-recoil buffer should not be removed.

Reassemble as follows:

Force the piston rod and cylinder head forward into place and assemble the front nut on the piston rod. Screw the rear cylinder head into its seat, taking care that it is seated firmly. Force the piston rod forward until the piston is against the front end of the cylinder and tighten the follower. Release the elevating friction clamp, and by means of a jack under the breech bring the gun to the horizontal. Insert the left recoil spring, screw up the spring-case extension, and replace the spring-case extension stud bolt. By means of the jack further depress the piece until the gun moves slowly and gently into the firing position by pushing on the breech. If the gun does not slide readily, it may be necessary to use tackle and shock as described above for moving the gun rearward. Refill the cylinder with hydrolene oil. Adjust the front piston-rod nut so that the distance from the front face of the piston-rod lug to the rear end of the cylinder is the same as it was before dismounting. The spring yoke and rear nuts

should be replaced on the three rods and the nuts on the spring rods tightened until the front nuts, which have not been moved, bear firmly against the yoke.

870. To remove packing from stuffing boxes.—When difficulty is experienced in removing packing from stuffing boxes with the hooks provided for the purpose the following method may be used with success:

Force the packing extractor down on the packing and turn in a contraclockwise direction until the hooks have engaged in the packing and are turning it. Then continue to turn in a contraclockwise direction and pull the extractor outward gently at the same time. The packing will conform to the threads of the stuffing box and may be brought out easily and without injury to threads or packing.

871. To repack stuffing boxes.—Unscrew the follower and be careful to remove the ring gland. Remove the old packing, and if any of it is fit for use again it should be put in after the new.

In general, six rings of Garlock's packing are required for packing each box. Put one ring at a time on the piston rod, breaking joints. Force well to the bottom of the stuffing box by means of a wooden stick and mallet. Treat each layer of packing in a similar manner until the proper thickness of packing has been attained. Now put the gland in place and screw up the follower. No more force than that of two men should be put on the spanner wrench, and generally that of one man will be sufficient. The addition of a pipe to the end of the spanner wrench should not be permitted.

872. Dismounting breechblocks of heavy cannon.—Open breech, remove the firing attachment, and place a shot truck with its tray under the mushroom head, elevating the tray until it bears the weight of the mushroom head and spindle. Remove the spindle nut and move truck back so as to withdraw the spindle from the block. Remove the split rings, gas-check pad, and filling-in disk.

To assemble, proceed in the reverse order. The firing attachment should not be placed on spindle until the mushroom head has been adjusted.

For further instructions in dismantling, dismounting, and caring for breechblocks, see Ordnance Pamphlet on Breech Mechanism for Seacoast Cannon, No. 1665.

873. To adjust pad.—Close the breech with the spindle nut loose, but not loose enough to permit slipping of the pad or split rings, rotate the block one-half. With the mechanism in this position screw up the spindle nut as tight as it can be screwed with the wrenches provided.

It is necessary to insert the end of a screw-driver in the opening of the nut in order to spread it sufficiently to allow its rotation without rotating the spindle.

Clamp the spindle nut and rotate the breechblock until the breech is closed completely. This last operation presses the pad into its seat, due to the forward motion of the block.

Then the pad should be in proper adjustment for firing; this may be tested by turning the mushroom head by hand. It should turn easily, but without play.

874. Examination of the breech mechanism of mounted guns.—The breech mechanism of mounted guns should be operated at least once each week, and such parts of it as need cleaning should receive proper attention. If necessary, the tray is removed in order to clean the worm, worm shaft, the spiral gear, and their recesses.

The mechanism should be oiled frequently, especially the worm shaft and the hinge pin; synovial oil is issued for this purpose.

875. The breechblocks of 10-inch and 12-inch B. L. rifles, model 1888, mounted on barbette carriages should not be opened when the gun has an elevation of more than 1° , since with a greater elevation the crank of the translating roller is liable to be bent by striking against the right cheek of the top carriage.

On account of this interference neither of these guns should be elevated or depressed while the breech is open.

876. Firing mechanisms.—Firing mechanisms should not be left on any gun or mortar out of service, but should be kept dismantled in the box provided for the purpose. All parts must be kept oiled and entirely free from dust.

877. Projectiles for target practice.—Unless special instructions are given, cast-iron shot or shell of service weight and form are used. When necessary, sand may be used in the cavity of shell to bring them up to the proper weight. Sawdust may be mixed with sand to fill the cavity completely, or the sand may be wet to secure the desired weight. Fixed ammunition for target practice is issued upon proper requisitions, the projectiles of which are of proper weight and without bursting charge or fuse.

878. Piling projectiles.—Projectiles when received at a post are unboxed and piled with points to the wall, base out, so that they may be inspected easily.

879. Packing boxes for projectiles.—The packing boxes in which projectiles are received should be kept until the projectiles are used.

880. Painting projectiles.—Projectiles are painted as prescribed in ordnance pamphlets 1869 and 1877, and in case the galleries are wet the projectiles after painting should be slushed. The distinctive color to indicate the character of the bursting charges is not applied until the projectiles shall have been filled, after which the entire base of each projectile shall be painted the required color at once.

881. Loading projectiles.—Instructions for loading projectiles with high explosive are contained in Ordnance Pamphlet No. 1727.

882. Care of empty metallic cases and primers.—After the expenditure of ammunition in target practice with guns using metallic cartridge cases the empty cases are taken up on the

property return of post as "empty metallic cartridge cases," under the heading provided for that purpose. Immediately after firing the cases should be decapped, cleaned well by washing inside and out, and dried.

All obturating electric and friction primer cases should be cleaned immediately after firing and turned in to the post ordnance officer for shipment to Frankford Arsenal, as provided for .30-caliber shell.

883. Cartridge storage cases.—Whenever it may be necessary on account of weather conditions or for other adequate reasons to delay target practice the following method of resealing cartridge storage cases temporarily is provided for the proper protection of the smokeless-powder charges:

Support the cartridge storage case in a horizontal position on a table or bench, and after pressing the lid firmly on the case apply melted paraffin with a brush to the joint between the lid and the cartridge storage case, at the same time turning the latter rather rapidly at first, but more slowly as the paraffin sets. Continue this operation until a thick coat, entirely covering the joint, has been formed. Each layer should be allowed to set before applying the next one. Before putting on the lid the joint between it and the cartridge storage case should be made clean and dry. No special skill is required in this work, and if the paraffin is kept hot and thoroughly liquid and care is used in applying it, the joint will be waterproof and will stand ordinary handling. In turning the cartridge storage case while applying the paraffin care should be exercised not to allow the powder charge to strike against the lid, as any severe jar or blow is liable to crack the coat of paraffin, especially after it has set and become brittle. Rubber tape may be used at the joints for temporary sealing. If conditions are such that the powder charges contained in cartridge storage cases that have been broken open and resealed in the manner described may not be used within six months from the date of opening the cases, report should be made to the district armament officer, who will take steps to provide for the resealing of the cases by soldering.

Cartridge storage cases should be handled as little as possible after sealing in the manner described, and should be stored where other articles will not be placed upon them.

In reopening the cartridge storage cases the paraffin may be removed readily by striking it lightly with a hammer or an iron bar and then scraping the joint with a chisel.

884. To carry out the foregoing instructions the following material is issued to ordnance officers of artillery districts:

Two .75-inch brushes.

One 2-quart enamel saucepan.

Twenty pounds of paraffin.

Paraffin will be replaced upon requisitions submitted in the usual manner.

885. Powder.—Powder issued to the batteries for target practice or action is stored and cared for in service magazines, as

provided in War Department memoranda, general orders, and circulars.

Instructions for preparation and care of powder charges are contained in Ordnance Pamphlet No. 1872.

Directions for blending and drying powders stored at forts are contained in Ordnance Pamphlet No. 1871 and Artillery Memoranda.

886. Instructions for the shipment of explosives are found in Ordnance Pamphlet No. 1720 and in the pamphlet on this subject issued by the railroad companies under the interstate-commerce law.

887. Care of telescopes.—The prisms and lenses in the telescopes of position finders, azimuth instruments, and sights are not arranged for adjustment by those using them; the taking apart of telescopes for any purpose, and the making of any adjustments other than those provided for in their construction and described in the pamphlets issued by the Ordnance Department, except under the supervision of district armament officers, are forbidden.

When telescopes or any instruments of the range-finding and fire-control system for coast artillery issued by the Ordnance Department require repair, a report describing the character and extent of the injuries or defects is made to the armament officer of the district. In case the repairs or adjustments required by telescopes and other delicate instruments of precision are of such a nature that they can not be made at the post the instruments are shipped by express to such arsenal as may be designated by the district armament officer.

888. Paulins.—Specially shaped paulins for the protection of seacoast guns and carriages at fortifications on the Atlantic coast north of the fortieth parallel of latitude are provided by the Ordnance Department upon requisition. Paulins for other fortifications than those named above or for other purposes are provided only in cases of extreme necessity, which should be explained fully in each instance.

889. Electrical installations.—In general, the care and preservation of engineer, signal-corps property, fire-control installation, power and electric plants is charged to the artillery engineer. In this duty he is assisted by master electricians, engineers, electrician-sergeants, first and second class, firemen, and master gunners.

For information concerning the methods to be employed in carrying out the above instructions, see Signal Corps Manual No. 8, Submarine Mine Manual, engineering circulars (Signal Corps), mimeographs (engineer), Artillery Notes, and other available publications.

Telephones and telautographs or other portable apparatus which is exposed to the weather when installed at batteries out of commission may be removed and placed in a storeroom. (See paragraph 606.) This does not apply to batteries in commission but out of service.

890. Care-taker detachments.—The duties to be performed by care-taker detachments consist of—

(a) Care, preservation, and protection of all government property.

(b) General police of the batteries, power plants, fire-control stations, and other public buildings and of their immediate surroundings.

(c) Enforcing the regulations relating to persons coming on government reservations and visiting or inspecting the batteries or buildings.

891. The care of a battery includes, in addition to the care of the battery proper and its armament, the care of all buildings, rooms, fire-control stations pertaining thereto and of the contents thereof.

892. The care and preservation of all ordnance property is in the charge of an ordnance-sergeant when practicable.

893. The care and preservation of all engineer and signal property is in the charge of an electrician-sergeant when practicable.

894. The general protection of all government property and the police of batteries, buildings, and surroundings is in the charge of a noncommissioned officer of Coast Artillery, who is also in command of a detachment of privates of Coast Artillery detailed to assist the ordnance-sergeant in the care and preservation of the public property in his charge, to guard the reservation against the intrusion of unauthorized persons, and to police the batteries, buildings, and grounds.

895. At subposts where an ordnance or electrician sergeant is not provided the noncommissioned officer of artillery in command of the artillery detachment acts as such.

896. The composition of artillery detachments to assist ordnance-sergeants is determined on the following basis: One private to every 2 guns of 6-inch or greater caliber; 1 private to every 2 mortars; 1 private to each rapid-fire battery of 4 guns or less below 6-inch in caliber: *Provided*, That in no case shall a care-taker detachment consist of less than 1 noncommissioned officer and 3 privates.

897. One private, in addition to those authorized in the preceding paragraph, is detailed to cook for the detachment when it messes separately.

898. The noncommissioned officer of artillery in command of the artillery detachment is held responsible for the good order and military discipline of his detachment. He details the privates of the detachment as watchmen of the batteries, buildings, and grounds in accordance with a roster kept for that purpose. At least one man is on watch at all times. The watch tour is of such duration as the commanding officer of the artillery district may prescribe, not to exceed eight hours. During the time that a man is on watch he makes the rounds as prescribed by the district commander at least once every two hours.

CHAPTER XIX.

STORAGE AND HANDLING OF EXPLOSIVES.

GENERAL INSTRUCTIONS.

899. At least once each calendar month each officer responsible for the care of explosives stored at posts shall inspect personally each place where such explosive is stored. At this inspection he shall see that the requirements of these instructions for the storage and handling of explosives are being observed carefully. He shall report to his post commander the result of his inspection.

900. Remove all dirt, grit, and foreign material from cases before placing them in storage.

901. Avoid sliding or rolling cases. Lift, carry, and deposit them with care.

902. One of the most important requirements in the care of any explosive is absolute cleanliness in and about the place where the explosive is stored. By removing all foreign materials from a magazine the chances of accidents are reduced greatly. The ground around the storage place must be kept free from leaves, long grass, brush, débris, or anything which may increase the fire risks.

903. Officers charged with the receipt and storage of explosives shall direct personally the work of handling the cases and shall select men who, either by previous experience or reputation for care and steadiness, are well qualified for the work.

904. Never expose cases of explosives to the direct rays of the sun longer than is absolutely necessary. Cover them with a paulin or similar cover in such a way as to admit of the free circulation of air. The effect of the direct rays of the sun on a metallic case is to raise the temperature inside the case to a point considerably above that of the open air, and this temperature is maintained for a considerable time after the exposure.

905. In opening cases avoid as far as possible the use of implements which may produce sparks. Suitable implements are a wooden mallet or copper hammer and a wooden wedge or copper chisel. Use a hammer only when necessary, and then as lightly as possible.

906. The keys of magazines and storage places must be kept in the hands of thoroughly reliable and responsible persons.

907. Whenever there is more than one kind of explosive in a storage place but one kind shall be placed in a pile, and the different kinds separated as much as possible.

908. Only those explosives mentioned herein as being suitable for storage together shall be placed in any single storage place.

909. Free circulation of dry air is most desirable in any place where explosives are stored. Cases should always be raised off the floor of the storage place and placed on skids.

910. If a storage place is artificially heated or from climatic conditions the temperature of the air is liable to rise above 100° F., a maximum thermometer shall be suspended therein and the temperature watched carefully during the period of excessive heat. Should a temperature as high as 100° F. be maintained for any length of time the place must be cooled or the explosive removed.

911. Black powder is now supplied to the service in relatively small quantities. It must never be stored with other explosives.

912. Black powder must be kept dry, and on account of the danger of explosion by ignition must be protected thoroughly from all fire risks.

913. Matches and unauthorized lights shall not be permitted in any magazine.

914. No loose explosive shall be permitted in any building, except such as is being used actually in preparing charges.

915. Empty ammunition cases shall never be stored with filled cases.

916. A copy of these instructions shall be hung in a convenient place in every magazine containing explosive, for the information and guidance of all concerned.

COMMERCIAL DETONATORS.

Package.

917. These detonators are supplied in pasteboard boxes containing 50 detonators, and the pasteboard boxes are shipped in suitable wooden boxes.

Storage and care.

918. Commercial detonators may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to temperatures greater than 100° F.

919. Under no circumstances may detonators be stored with other explosives, except fuses and primers, and temporarily with dry gun cotton when in the fuse cans preparatory to loading mines. (See Dry gun cotton.)

920. On account of the sensitiveness of mercury fulminate, the filling charge of the detonator, to detonation by a blow, special care must be exercised in keeping individual detonators off the floor or other places where they may be exploded by stepping on them or dropping heavy articles on them.

921. Never handle the detonators by the wires in such a way that the detonator itself may be brought in violent contact with any object.

Inspection.

922. The inspection of this class of explosives shall be limited to seeing that the requirements of Storage and care are observed strictly.

DYNAMITE.

Package.

923. Dynamite cartridges are packed ordinarily in sawdust in wooden boxes. Each cartridge is wrapped in paraffin paper. The cartridges are arranged in the box so that when they are transported all cartridges will lie on their sides and never on the ends. Usually the amount of explosive in a single package will not exceed 50 pounds.

Storage and care.

924. The boxes must never be allowed to stand so that the cartridges will be vertical.

925. Like other nitroglycerin mixtures, dynamite freezes at about 40° F., and in its frozen condition is, under ordinary circumstances, less liable to explosion from detonation or percussion than when thawed, but more susceptible to explosion by simple ignition. Should any of the nitroglycerin be exuded, the dynamite cartridges are much more sensitive to explosion by a blow.

926. It is important that dynamite cartridges be kept dry. If exposed to a moist atmosphere, there is a tendency of the water, condensed from the air on all exposed surfaces, to displace the nitroglycerin.

927. The cases should be raised from the floor on skids and the floor underneath covered with clean sawdust. The sawdust should be removed from time to time, the old sawdust being burned in the open air.

928. Rubber gloves should be worn in handling this explosive, or in the absence of rubber gloves cover the hands with grease and wear cotton gloves. This is for the protection of the skin from the injurious effect of nitroglycerin.

929. Dynamite may be stored with wet gun cotton and explosive D.

930. Date of receipt at post shall be marked on each box.

Inspection.

931. At the monthly inspection all boxes shall be examined to see if they are dry. If not dry, all shall be exposed to the dry air out of the direct rays of the sun.

932. The principal source of danger from dynamite is in the exudation of the nitroglycerin. Exudation is indicated by the presence of small white, oily, lustrous globules of liquid

either among the particles of dynamite or on the packages. If such globules are discovered, they may be identified positively as nitroglycerin by absorbing a drop in a piece of unglazed paper, which should be placed on an anvil or other piece of metal and striking it a sharp blow with a hammer. If it be nitroglycerin, an explosion will occur. Another test is to set fire to the paper, and if the liquid be nitroglycerin it will burn with a crackling noise and a greenish-yellow flame.

933. If exuded nitroglycerin has stained floors or other material not readily destroyed, the nitroglycerin may be decomposed and rendered harmless by washing with sulphur solution. Sulphur solution may be made by boiling 50 pounds of lime in a barrel of water and adding powdered sulphur until the solution will take up no more. This will require about 20 pounds of sulphur. The resulting bright orange-colored solution should be filtered and only the filtrate used. A suitable filter for this purpose is a piece of thin cheese cloth. Sodium carbonate may be used in the place of lime.

934. Dynamite may be destroyed by burning in small quantities at a time. Slit the cartridge with a knife, spread out the contents over some straw or shavings, and ignite carefully. Do not attempt to burn frozen dynamite.

EXPLOSIVE D.

Package.

935. Explosive D is contained in double paper bags containing about 100 to 125 pounds of explosive. These bags are inclosed either in the standard cartridge storage cases or in strongly hooped wooden barrels painted inside with rubberine or other authorized paint.

Storage and care.

936. This explosive must be stored in a perfectly dry place, preferably in a magazine. If it is impracticable to store in a magazine, the explosive may be stored in the driest place available where it is protected thoroughly from all fire risks.

937. The barrels are stored on end, marked end uppermost.

938. Date of receipt at post shall be painted on each barrel.

939. There shall be no cards or other material tacked on the barrel.

940. There shall be no nails driven in the barrel.

941. If from any cause the barrels of explosive are wet and there is a reasonable assurance that the interior has become wet, a barrel shall be selected and opened. If the interior is wet, a full report of the circumstances shall be made to the War Department. If the interior is dry, the barrel shall be reheaded carefully and all barrels dried in the open air out of the direct rays of the sun.

942. Explosive D may be stored with wet gun cotton and dynamite.

Inspection by the Ordnance Department.

943. Technical inspection is confidential.

Inspection at posts.

944. No technical inspection of this explosive shall be made at posts except by the Ordnance Department.

945. Barrels shall not be opened for the purpose of inspecting the contents.

946. If any barrel shows signs of drying out and opening at the staves or head, all barrels shall be given a coat of rubberine or other authorized paint.

FUSES AND PRIMERS.

Package.

947. Fuses and primers are packed in hermetically sealed metallic boxes, inclosed in suitable wooden containers. These boxes are not to be opened until the fuses and primers are required for use.

Storage and care.

948. Cases of fuses and primers may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to a temperature greater than 100° F.

949. Under no circumstances may fuses and primers be stored with other explosives except the commercial detonators used in submarine mines.

Inspection.

950. The inspection of this class of explosives shall be limited to seeing that the requirements of Storage and care are observed strictly.

GUN COTTON.

Package.

951. Wet gun cotton for submarine mines is supplied in boxes containing approximately 100 pounds of dry gun cotton with 25 pounds of water absorbed; total weight, 125 pounds. The boxes are lined with zinc and the lids are screwed down upon a rubber gasket. There is an opening in the lid for replacing water lost by evaporation. The manufacturer's name, the date of nitration, net and gross weights are stamped on each box. The object of having the gross weight on the box is to give an easy means of checking the amount of water contained in the gun cotton at the time of the quarterly weighing.

Storage and care.

952. Magazines in which gun cotton is stored should not be allowed to attain a temperature as high as 100° F. for any length of time.

953. Gun cotton which is *kept wet* may deteriorate after long storage, but will not become dangerous.

954. Wet gun cotton can not be ignited by a flame, but gradually smoulders away as the outer portions in contact with the flame become dried.

955. A brownish or reddish shade is sometimes seen in cakes of gun cotton. This is due to the presence of iron in the wash water and does not indicate decomposition.

956. When storing gun cotton in the magazine the piles of boxes should be made so as to give free circulation of air and the greatest convenience in handling consistent with the capacity of the magazine.

957. In the event of damage to any case, which may cause loss of water by evaporation, the contents shall be removed at once, repacked in a gun-cotton box which has been washed with soda solution, the proper amount of water added to the contents, and the box closed. The gross weight shall be marked on the case. In repacking avoid as much as possible handling the cakes with the bare hands. This is for the protection of the gun cotton from oil or acid of any kind. Clean cotton or rubber gloves are suitable covering for the hands when engaged on this work.

958. If for any reason the cases are subjected to dampness sufficient to cause unusual deterioration of the cases, they should be removed from the magazine and dried out of the direct rays of the sun.

959. Gun cotton containing 25 per cent of moisture may be stored with Explosive D or dynamite, but *never with dry gun cotton*.

960. Empty cases, before being placed in storage, must be washed thoroughly to remove all traces of gun cotton.

Inspection by the Ordnance Department.

961. Samples of each lot of gun cotton issued to the service are preserved in the laboratory of the Ordnance Department for chemical test. These retained samples are subjected regularly to technical inspection and test by that department to determine their condition as to stability. This will insure the detection of lots that are deteriorating and their removal from the posts or their destruction, before they have deteriorated to such an extent that they become dangerous.

Inspection at posts.

962. In addition to the regular monthly inspection, at the end of each quarter the officer responsible for submarine-mine explosive shall supervise the weighing of each box of gun cotton under his care. Any loss in the gross weight shall be

made up by the addition of distilled water poured through the filling hole. Water thus added will be absorbed gradually by the charge.

963. No further inspection of this explosive is necessary.

Dry gun cotton.

964. Dry gun cotton is used for submarine mine primers.

965. Primers are not to be prepared until just previous to the time they are to be used in loading. Therefore the period of storage will be short and no particular examination of the dry gun cotton will be required.

966. Dry gun cotton during the interval between loading in the mine case and the time dryness is secured shall be stored ordinarily in an assembled fuse can. When prepared in this manner it shall be kept in a cool, dry, and secure room away from all other explosives.

967. Dry gun cotton should be handled as little as possible to prevent crumbling and scattering of gun-cotton dust. Finely divided gun cotton is difficult to remove by brushing, and if allowed to collect about a room may give serious trouble by "flashing" should a portion become ignited. This dust may be removed with a damp sponge or cloth.

968. Dry gun cotton which is not used as contemplated shall be rewetted with the proper amount of water and repacked.

SMOKELESS POWDER.

Package.

969. Powder charges are now supplied to forts in hermetically sealed cases and shall be opened only in accordance with War Department instructions.

Storage and care.

970. Smokeless powder shall be stored in the driest available magazines. So long as the container remains sealed the only effect of water is to cause unusual deterioration of the case.

971. No magazine in which the temperature of the air rises above 95° F. shall be used for the storage of smokeless powder.

972. Notwithstanding the great care taken in sealing storage cases it is almost impossible to prevent some slight escape of volatiles, therefore a slight odor of ether in a magazine is not unusual and does not indicate deterioration. However, if the ether odor is persistently strong it indicates a leaky storage case, which should be found by a process of elimination. When a leaky case is found or the seal of a storage case of powder discovered to have been accidentally broken the fact should be reported to the War Department for decision as to the disposition of the powder charges contained therein.

Inspection by the Ordnance Department.

973. Samples of each lot of smokeless powder issued to the service are preserved in the laboratory of the Ordnance Department for chemical test. These retained samples are subjected regularly to technical inspection and test by that department to determine their condition as to stability. Should any lot show deterioration the change is discovered by such inspection and the entire lot recalled from posts where it is stored.

Inspection at posts.

974. With each lot of powder supplied to a post there shall be furnished a ground glass stoppered bottle containing a sample of the particular lot of powder. This bottle shall be stored in the magazine with the corresponding lot of powder. The object of preserving this sample bottle in the magazine is to enable the responsible officer to keep his powder under regular observation.

975. At each monthly inspection a piece of blue litmus paper, moistened with distilled water, shall be suspended just above the powder in the sample bottle. The paper, which must be kept moistened, shall remain in the bottle for six hours, when it shall be examined. If the paper has been reddened, the test shall be repeated, and if duplicated the facts shall be reported to the War Department at once.

976. A determination of the standard red (acid) color of the blue litmus may be made by dipping the paper in dilute vinegar or acid.

977. Avoid handling the litmus paper with the bare hands or anything which is capable of imparting color to the paper.

978. At all times, other than when inserting and removing the litmus paper, the sample bottle of powder shall be kept stoppered tightly.

979. No other inspection of smokeless powder shall be made at posts.

PROJECTILES, FILLED AND FUSED.

Storage and care.

980. These projectiles shall be stored in the magazines provided for them, piled, and painted as required by existing orders.

981. They shall be kept dry as possible and free from rust.

982. While premature explosions are not expected, projectiles filled and fused shall be handled with care.

Inspection.

983. On account of the nature of the envelope no inspection of the explosive is possible. The inspection of the projectiles shall be limited to seeing that the requirements of "Storage and care" are observed strictly.

CHAPTER XX.

EXAMINATION FOR GUNNERS AND FOR SPECIAL RATINGS.

INSTRUCTION OF GUNNERS.

984. This instruction is under the supervision of the fire or mine commander when a field officer is available for that duty. During the period of indoor instruction all enlisted men shall be required to attend the classes, except those extra and special duty men who are first-class gunners and who do not have to requalify at the next examination. Such first-class gunners as are not utilized as instructors shall be given an advanced course of instruction.

985. Its object is to impart knowledge of guns, mortars, mines, and accessories to the enlisted men of coast artillery. The period of indoor instruction shall be followed by an examination having for its object the determination of the number of qualified gunners in each company. The examination shall take place at the post where the respective companies may be serving and shall be separate for each company.

986. For purposes of instruction and examination, enlisted men of the Coast Artillery Corps not belonging to companies or batteries may be attached to convenient organizations, and upon qualification shall be classified as gunners.

987. A candidate to be eligible for qualification as first-class gunner must have qualified previously as second-class gunner, though both qualifications may be made at the same examination.

988. Boards of examination shall be convened annually in each artillery district by the district commander, to meet not less than one month after the expiration of the indoor instruction period. Separate boards may be convened for the examination of candidates for first and for second class gunners, and also for posts attached to the artillery district. All boards shall consist of three artillery officers, selected with reference to their special qualification for this duty; provided that when a member of the board is a company commander he shall be relieved during the examination of candidates from his company and the examination conducted by the remaining members. Where travel is necessary the selection of an officer for this duty shall be made subject to the approval of the authority competent to order the necessary journeys.

989. Previous to the commencement of the examination each company commander shall submit to the adjutant a duly signed list, in triplicate, giving the full names, arranged in muster-roll order, of all the men of his company who are to be

examined for first or second class gunners, with the statement that he believes each man so presented is capable of qualifying in the class designated. These lists shall be transmitted to the senior member of the board by the post commander.

990. The examination of gunner candidates shall be held, as far as practicable, at such places as the material or equipment pertaining to the subject in hand is located, i. e., at the battery or in a fire-control station.

991. In determining the qualifications of candidates credit shall be given for practical knowledge of subjects rather than for text-book answers to questions.

992. The qualifying mark for classification as first or second class gunner shall be in each case not less than an average of 75 per cent. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on subjects for which he has already been examined, increased by the maximum allowed for the remaining subjects, is less than 75, his examination shall be discontinued.

993. The board shall keep a record of its marks during the examination, but these marks shall not be published in orders. The report of the board on each company shall be sent as soon as possible after the completion of the examination to the artillery district commander, who shall publish an order announcing the names of those who have qualified as first and second class gunners, the names being arranged for each organization in each class in muster-roll order, and reciting the date of qualification in each case, the date of the completion of the company examination being taken as the date of qualification.

994. The scope of the examinations for first and second class gunners and the relative weights to be given the subjects are as follows:

For candidates in companies assigned to gun defense:

For second-class gunners:

(a) Service of the piece.....	25
(b) Guns and carriages.....	25
(c) Powders, projectiles, primers, and fuses.....	25
(d) Cordage, gins, shears, jacks.....	15
(e) United States magazine rifle.....	10

100

For first-class gunners:

(a) The azimuth instrument.....	20
(b) Duties in the plotting room.....	50
(c) Aiming and laying guns or mortars.....	15
(d) Definitions C. A. D. R.....	5
(e) War ships.....	10

100

For candidates in companies and detachments assigned to mine defense:

For second-class gunners:

(a) Ammunition, nomenclature, and service of guns to which the candidate's company is assigned.....	15
(b) Material of and duties in the loading room (except electrical principles involved).....	35
(c) Material for and duties on the water.....	30
(d) Cordage.....	10
(e) United States magazine rifle.....	10

100

For first-class gunners:

(a) Care and preservation of mine material.....	15
(b) Handling high explosives.....	20
(c) Knowledge and use of the azimuth instrument and plotting board.....	20
(d) Engines, generators, transformers, storage batteries, and searchlights assigned to the company of which the candidate is a member.....	20
(e) Operation of casemate apparatus and of telephones.....	20
(f) Definitions C. A. D. R.....	5

100

995. The examination of candidates for first-class gunners of organizations assigned exclusively to rapid-fire guns not provided with separate fire-control system shall include the following head in lieu of that given under (b) for companies assigned to gun defense:

(b) Subcaliber firing	50
-----------------------------	----

996. The examination in subjects (a), (b), and (c) for both second-class and first-class gunners shall be confined to the material of that part of the defense to which the company is assigned. If no azimuth instrument is included in the battery equipment the instrument used in the instruction shall be used in the examination.

QUALIFICATION OF RATED ENLISTED MEN.

997. In each company of coast artillery examinations shall be held by the company commander under the direction of the fire or mine commander, at such times as the latter may prescribe, for the purpose of determining enlisted men who are qualified for appointment to rated positions.

998. Records shall be kept in each company in the form of eligible lists for each rated position to which enlisted men of the company may be appointed.

999. Examination for rated positions shall be confined to first-class gunners or enlisted men who have once been classified as first-class gunners. Candidates who pass with an aver-

age of 75 per cent any of the examinations prescribed for rated enlisted men shall be carried on the eligible list for appointment to the corresponding rated position for a period of three years from the date of examination.

1000. Enlisted men on the eligible list for a rated position shall be classified as first-class gunners from the date of qualification and so announced in district orders, and such classification shall be continued for the time they are entitled to remain on such eligible list. When a man's term of eligibility for any rated position expires he may be continued in such rated position or on the corresponding eligible list by passing a new examination for such rated position, and his classification as first-class gunner shall be continued without further examination.

1001. The same enlisted man may be carried on several eligible lists providing he passes satisfactorily the prescribed examinations for such rated positions.

1002. Prior to the examination for the rated positions of observers, first or second class, or gun pointer, the candidates shall be examined by the post surgeon for defective vision, and no candidate shall be rated for these positions who has any defect in vision which would impair his efficiency.

1003. An enlisted man now holding a rated position need not be required to take the examination for that position until the termination of the three-year period from the date of his last classification as a first-class gunner, unless his qualifications for the position he holds have not been established to the satisfaction of the fire or mine commander concerned or the artillery district commander, in which case he shall be required to take the examination for that position at such time as may be prescribed by the fire or mine commander concerned. In the event of his failure to pass satisfactorily the prescribed examination he shall be disgraced immediately by the artillery district commander.

1004. The scope of the examination for each of the rated positions is as follows:

Gun commander and gun pointer.

I. Definitions C. A. D. R.

II. Gun and carriage.

- (a) Nomenclature, purpose, and action of several parts.
- (b) Packing stuffing boxes and cleaning recoil cylinders.
- (c) Adjustment of—
 - Quadrant elevation device, sight standard, throttling valve, gas-check pad, elevating gear, grease cups, and firing mechanism.
- (d) Care and preservation, including care of hand counterweights, oiling, and painting.

- III. Powders, projectiles, fuses, and primers.
 - (a) Ventilation of magazines.
 - (b) Blending powder and preparation of powder charges.
 - (c) Filling and fusing projectiles.
 - (d) Painting projectiles.
 - (e) Care of empty cartridge cases and primer bodies.
- IV. Preparations for service or subcaliber practice.
- V. Service of the piece.
 - (a) Duties of each member of the gun section under all conditions.
- VI. Precautions for safety at the battery.
- VII. Fire-control system.
 - (a) General knowledge of that in use at the battery.
 - (b) Duties of range keeper; object and use of time range board.
- VIII. Pointing.
 - (a) Methods of pointing and pointing tests.
 - (b) The telescopic sight (the quadrant for mortars).
 - (c) Emergency system and salvo points.
 - (d) Bore sighting and orientation.
- IX. Regulations governing service and subcaliber practice so far as they affect the service at the emplacements.
- X. Mounting and dismounting guns and carriages.
- XI. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

Plotter.

- I. Definitions C. A. D. R.
- II. Fire-control system.
 - (a) Detailed knowledge of system employed at the battery.
 - (b) Indication and identification of targets.
 - (c) Duties of each member of the range section under all conditions.
 - (d) Emergency system and salvo points.
- III. Fire-control apparatus.
 - (a) A detailed knowledge of adjustment and use of all fire-control apparatus used in the plotting room.
- IV. Elementary gunnery.
 - (a) Explanation of the several corrections to be applied to the observed range to obtain the corrected range.
 - (b) Effect on the flight of the projectile of variations in the density of the air; the direction and velocity of the wind.
 - (c) Use of trial shots and application of data obtained from them (problem).
- V. Preparation of target-practice records.

Observer (first or second class).

- I. Definitions C. A. D. R.
- II. Fire-control system.
 - (a) Detailed description of that in use at the battery.
 - (b) Indication and identification of targets.
 - (c) Emergency system and salvo points.
- III. Fire-control apparatus.
 - (a) A detailed knowledge of adjustment and use of all observing instruments and range finders in use at the battery.
 - (b) Use of the telephone.
- IV. Observer's test C. A. D. R.
- V. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

Casemate electrician.

- I. Definitions C. A. D. R.
- II. Casemate apparatus.
 - (a) Nomenclature.
 - (b) Testing.
 - (c) Circuits.
 - (d) Maintenance.
- III. Troubles and remedies.
 - (a) Lamps and bells.
 - (b) Switches.
 - (c) Ammeters and voltmeters.
 - (d) Telephones.
 - (e) Engines and machines.

Chief planter.

- I. Definitions C. A. D. R.
- II. Mine planting material.
 - (a) Voltmeter test of a mine circuit.
 - (b) Hydraulic jacks.
 - (c) Nomenclature and use of apparatus aboard mine planters used in planting mines.
 - (d) Capacity of falls and winches.
 - (e) Automatic anchor.
- III. Drill.
 - (a) Duties of noncommissioned officer on distribution box boat.
 - (b) Duties of noncommissioned officer in charge of planting mines from mine planter.
 - (c) Boat drill with yawl boat.
- IV. Emergencies.
- V. Cordage.

Chief loader.

- I. Definitions C. A. D. R.
- II. Explosives.
 - (a) Storage of explosives.
 - (b) Gun cotton.
 - (c) Drying gun cotton and gun-cotton primers.
 - (d) Preparation of gun-cotton primers from square cakes.
 - (e) Dynamite.
 - (f) Nitroglycerine.
 - (g) Evidence of free nitroglycerine in dynamite.
 - (h) Method of decomposing nitroglycerine to render it harmless.
 - (i) Preparation of priming charges.
- III. Fuses.
 - (a) Description.
 - (b) Tests.
 - (c) Storage of fuses.
 - (d) Preparation of fuses for loading plugs.
- IV. Loading-room duties.
 - (a) Testing transformer and measuring the resistance of its circuits.
 - (b) Assembling and testing a compound plug.
 - (c) Loading a mine and preparing it for delivery to planter.
- V. Unloading mines.
 - (a) Precautions.
 - (b) Returning charge to storage boxes.
 - (c) Determination of amount of water to add to gun cotton.

INDEX.

[Numbers refer to paragraphs.]

A.

Abbreviations and symbols, fire-control stations	116
Abnormal corrections, gun arm	493
Absolute deviation	97
Access to power plants	608
Accountability of ordnance officer	597
Accuracy of D. P. F.'s	328
Adjustment, azimuth instrument	754
indices	527, 529
Lewis D. P. F.	774-779
pads	873
plotting board	782-785
quadrants	530
range board	799
retraction ropes	402
subcaliber guns	633
Swasey D. P. F.	770-773
telescope	820
Aeroscope	751
Aiming	21
Allowance of cleaning material	840
of paints	850
All-round fire carriage	67
Ammunition, dummy	341, 394
fixed	70
reserve	315
subcaliber	640
Ammunition hoists, care of	835, 836
definition	22, 192, 236
Ammunition recess	23
Ammunition section	283
Ammunition service, care of apparatus	835, 836
chief of	72, 373, 403
gun, 12-inch, disappearing carriage	403-405
gun, 10-inch, disappearing carriage	409
gun, 8-inch, disappearing carriage	414
gun, 6-inch, disappearing carriage	422, 424
gun, 12-inch, barbette carriage	434
gun, 10-inch, barbette carriage	437
gun, 8-inch, barbette carriage	440
gun, 6-inch, pedestal	444
gun, 5-inch, 4.7-inch	447, 448
gun, 3-inch	453-455, 457
gun, 6-pounder	463-467, 472
mortar battery	373-375
target practice	674
test of	628
Anemometer	752
Angle, of departure	24
of depression	28
of fall	25
of impact	26
of incidence	27
of jump	143
of position	28
striking	240
Apparatus, fire-control	Chapter XVII
Appointment of rated enlisted men	292, 293
Approaches	30

[Numbers refer to paragraphs.]	
Apron	29
Arbitrary deflection correction	675
Area, battle	47
Armament, accessories for effective use of	11
care of, post commander	599
manning tables for	159, 286
primary, intermediate, secondary (<i>see also</i> Gun battery and Mortar battery)	5, 6, 8-10
Artillery district, the	Chapter XI, 19
commander. (<i>See</i> District commander.)	
engineer	591-596
how designated	20
how established	580
manning tables	286
ordnance officer. (<i>See</i> Ordnance officer.)	
Artillery district headquarters, how designated	580
personnel of	581
Artillery drill. (<i>See</i> Drill.)	
Artillery engineer, breakdowns	607
care of electrical installations	889
care of machinery, storage batteries, etc.	611
communications, fire control and power plants, out of commission	605
definition	31
district	591-596
duties at drill	604
failures of apparatus	607
fire control stations, care of	610
inspections	591
maintenance of apparatus	609
maintenance of communications	602
material for repairs	603
post	610, 611
power plants	608
records	607
repairs	602
reports	607
responsibility of	605, 609, 610
supervision of electrician sergeants	613
tests of communications and mine cable	596, 605, 606, 734
visual signaling	602
Artillery inspection	Chapter XIII
battery commander	624, 627
district commander	585
duties of gun commander	625
duties of pit commander	626
fire-control stations	623, 628
gun emplacements	622, 625, 628
inspector	622-628
mortar pit	362, 626, 628
order of inspection	622
preparations for	621
range officer	623
Artillery instruction, service at emplacement	Chapter VI
Artillery material, care of	Chapter XVIII
Artillery practice. (<i>See</i> Target practice.)	Chapter XIV
Assignment of companies	278
Assignment of officers	274-277, 279-282
Atmosphere board, definition	32
description	749, 750
operation	750
use of	617
Attendance, artillery drill, record of	314
gunner's instruction	984
target practice	587
Automatic guns	156
Auxiliary horizontal base system, gun battery, primary armament	498, 499
mortar battery	517

[Numbers refer to paragraphs.]

Axis of gun	33
Axis of trunnions	34
Azimuth	35
Azimuth correction scale	761
Azimuth difference	36
Azimuth instrument	37, 753-755
adjustment of	754
description of	753
orientation of	754
use of	755
Azimuth, range table	204
Azimuth setter	38, 361, 363
Azimuth, wind	617, 618

B.

Banquette	41
Barbette carriage	67
Barometer	756
use of	617
Barrels for explosive "D"	937-941, 945, 946
Base-end stations	39
Base line	40
Batteries, definition	13
care of	832-834, 891
construction and maintenance of	837
naming of	14
Battery practice. (See Target practice.)	
Battery, the (see also Gun battery and Mortar battery)	13
assignment of companies to	278
assignment of officers	282
bore-sighting	526
dismissal of	312, 356
fire control	Chapter VII
general duties	Chapter V
general instructions	337-356
in commission	136, 832-834
in service	138, 832
inspection of	621-628
manning parties	286
night drill	697, 698
out of commission	832-834
out of service	832
service at the emplacement	Chapter VI
target practice, service	642-682, 689, 690
target practice, subcaliber	632-635
Battery commander	43, 277
access to power plants	608
appointment of rated enlisted men	292, 293
artillery inspection	621-628
assignment of officers	280, 282
auxiliary horizontal base system	498, 499, 517
commands of	355, 356
correction of fire	675-678
duties at drill	308, 312, 314-316, 319-323, 354, 355, 356, 480-487, 498-504, 509-512, 677, 678, 697, 698
emergencies	320-323
emergency system	502-504
fire command target practice	642-658, 683-685, 688
horizontal base system	487-497
independent action	319, 543
indication and identification of a target	480-486, 509
indoor instruction	317, 984-987
inspection	318, 624, 625
minor defects	609
modifications in fire control and drill	316
night drill	697, 698
records	314, 315
reports received	322

[Numbers refer to paragraphs.]

Battery commander—Continued.	
responsibility of	315, 609, 636, 655, 833
safety officer	684
subcaliber practice	631-641
vertical base system	500, 501
Battery commander's action	319, 543, 545
Battery commander's observer	323
Battery commander's station	44, 116, 321, 354
manning detail, gun battery primary armament	475-479
manning detail, mortar battery	505-508
Battery commander's walk	45
Battery parade	46
Battery practice, subcaliber	632-635
Battle area	47
Battle command	18, Chapter X
communication officer	570
communications	725, 726
designation	18
details	287, 289, 291, 317, 574
dismissal of	312
drill	569
fire-control system	575-579
indication of a target	576, 577
manning of	311
manning parties	575
manning tables	286
night drill	697, 699
rated men	293
searchlight officer	571-573
searchlights	572
service practice	642, 644, 647-658, 686-688
subcaliber practice	632, 635-638
typical	273
Battle commander, commands of	567, 578, 579
duties at drill	312, 567, 569, 576-579
fire commander's action	579
inspection	621-628
nature of command	565
night drill	697, 699
reports from fire commanders	309
reports from mine commanders	310
responsibility of	566, 567, 654
searchlight commands	720, 721
searchlights	572, 714
service practice	642-644, 647-658, 686-688
Battle commander's station	116
instruction of detail for	317
manning party for	310, 575
Bell, T. I.	251, 497
Blast slope	48
Blending powder	49, 885
Block, breech. (See Breechblock.)	
Board, atmosphere. (See Atmosphere board.)	
deflection. (See Deflection board.)	
mortar deflection. (See Mortar deflection board.)	
plotting. (See Plotting board.)	
range. (See Range board.)	
time range. (See Time range board.)	
Boat service	589
Book, emplacement	107
Booth, information	520
Bore	50
Bore plug	76
Bore sighting	51, 526
Bore sighting, orientation and pointing	Chapter VIII
Bourrelet	52
Breakdowns, of apparatus	607
of communications	323

[Numbers refer to paragraphs.]

Breach	53
Breachblocks	54, 55
care of	872-876
dismounting of	682, 872
target practice	673, 679, 680, 682
Breach detail, 12-inch gun, D. C.	389
Breach mechanism, care of	874-876
Breach recess	56
Breach reinforce	57
Buildings and grounds, police of	890, 891, 894
Bursting charge	58
C.	
Cable details	283
Cable, tests of	596, 606
Call to arms	311
Cannon	61
Cannoneers, changes in position of	343
Canopy	62
Capital	63
Carbons, searchlight	724
Care of, ammunition service apparatus	835, 836
armament, post commander	599
batteries in commission	832-834
batteries in service	832
batteries out of commission	832-834
batteries out of service	832
breachblocks	872-876
breach mechanism	874-876
carriages	862-871
cartridge storage cases	883, 884
cylinders, recoil	849, 862, 869
detonators	918-922
drains and sumps	843
dynamite	924-934
electric installations and power plants	889
empty metallic cases and primers	882
Explosive "D"	936-946
explosives	Chapter XIX
fire-control stations	605-610
firing mechanism	874-876
fuses and primers	882, 948-950
gas-check seat	680
gun cotton	952-968
guns	856-860, 888
hoists	835, 836
machinery, storage batteries, etc.	611
material	Chapter XVIII
mortars	856-859, 861-868, 870-873
parapets	843
platforms	843
powder	885, 911, 912, 970-979
primers	882, 948-950
projectiles	877-881, 980-983
projectiles, filled and fused	980-983
property, ordnance sergeant	892, 894
recoil cylinders	849, 862, 869
searchlights	723
signal property	893
smokeless powder	885, 970-979
stuffing boxes	870, 871
telautographs	741, 889
telephones	735-738
telescopes	819, 887
Caretaker detachments	890-898
Carriages, A. R. F.	67
barbette	67
care of	862-871
casemate	67

[Numbers refer to paragraphs.]

Carriages, cleaning recoil cylinders	869
coast	67
definition	64-67
disappearing	67
fixed	65
L. F.	67
masking mount	67
movable	66
packing stuffing boxes of	870, 871
painting of	852
parts of, not expendable	846
rapid-fire guns	67
recoil cylinders	849, 862, 869
wheeled	66
Caliber of guns	59
Calibration	60
Cartridges for 3-inch gun	453-455
Case I	68, 186, 531
Case II	68, 186, 532
Case III	68, 186, 533
Casemate carriages	67
Casemate detail	283
Casemate electrician, definition	69
examination for	1004
Casemate, manning party for	563
Cases, empty metallic, care of	882
Cases for gun cotton	956-960
Cases of pointing	68, 168, 531-533
Cases, powder, care of	882-884
Cease firing	653
Centering slope	50, 190
Chamber, powder	50, 190
Changes in fire-control system and drill	316, 543, 584
Changes in installation	316, 543, 584, 592
Changes in position of cannoneers	343
Charge, bursting	58
definition	70
powder, chute for	191
priming	199
Charts, powder	792-795
Chase	71
Chief loader, definition	73
examination for	1004
Chief of ammunition service, definition	72
gun, 12-inch, disappearing carriage	403
mortar battery	373
Chief of detachment	285, 295, 598
Chief of detail	285, 298
Chief of section	285, 295, 298, 302, 307, 308
Chief planter, definition	74
examination	1004
Chute, powder	191
Classification of searchlights	700
Cleaning bore and chamber	681
Cleaning material, allowance of	840
Cleaning recoil cylinders	869
Clinometer	75
Clinometer rest	76
"Close breech" gun, 12-inch, 1895 mechanism	384
gun, 12-inch, 1888 mechanism	382
gun, 12-inch, barbette carriage	430
mortar	370
Coast Artillery garrison	78
Coast Artillery reserves	78, 79
Combination primers	352
Command, tactical (<i>see also</i> Mine command, fire command, battle command)	245
Commands of battery commanders	355, 356
battle commanders	567, 578, 579
fire commanders	545

[Numbers refer to paragraphs.]

Commands, searchlight	720, 721
Commence firing	673
Commercial detonators	917-922
Communication detail	283
Communication officer	546, 547
assignment of	275
battle command	570
Communications	Chapter XVI
battle command	725, 726
breakdown of	323
defects in	606
failure of	498, 502
maintenance of	602
means employed	725
out of commission	605
signal stations	727
telautograph service	741-748
telephone operators	728-740
telephone service	728-740
telephone tests	733, 734
tests of	605, 606, 734
wireless	725
Companies, assignment of	278
Company commanders, appointment of rated men	292, 293
details by	289, 290
examination of rated men	997-1004
Company detail	283
Company, formation of	294-304
Company, gun	126, 283, 286
mine	162, 283, 284, 286
mortar	164, 283, 286
Computer	82
Construction of batteries	837
Continuance of qualification as gunner	1000
Control of searchlights	720
Corrected range	83
Corrections, abnormal	493
deflection	675-677
drift (<i>see also</i> Deflection board and mortar deflection board)	522
from observation of fire	675-678
how applied, battery secondary armament	525, 676
range	524, 525, 678
wind, gun battery secondary armament	522
Correction scale, azimuth	761
range board	801
Corridor	84
Corridor wall	85
Counter recoil	215
Counter recoil springs, assembling of	867
cleaning and painting of	868
preservation of	864-866
removal of paint from	868
Counterweight	86
Counterweight well	86
Cover post, mortar batteries	87, 363-367
Crane	88
Crest, exterior	110
Crest, interior	139
Curves, range board	802, 803
Cylinder, recoil, care of	849, 862, 869
definition	216

D.

Damage to, material	844
plotting room	503
Danger range	89
Danger space	89
Defects, in communications	606
in material	682, 689, 844

[Numbers refer to paragraphs.]

Defense of coast line	1-3
Defense plans	123, 567-569
Defense zone, inner	271
Defense zone, outer	271
Definitions	Chapter 11
Deflection, definition	90
arbitrary corrections	675
how set on sight	821
Deflection board	91, 757-768
azimuth correction scale	761
deflection scale	760
description of	757, 758
leaf range scale	764
multiplying scale	768
operation of	766-768
platen scale	758, 759
subcaliber board	765
T-square scale	763
use of	675
wind arc	762
Deflection board for mortars (<i>see</i> Mortar deflection board)	780, 781, 789
Deflection corrections	675-677
Deflection errors, mortar batteries	512
Deflection scale	760
Delivery table	92
Density of loading	93
Depression position finders	94, 189, 769-779
accuracy of	328
adjustment, Lewis D. P. F.	774-779
adjustment, Swasey D. P. F.	770-773
description of	769
D. P. F. system	189, 500, 501, 517
Designation of, battle command	18
searchlights	718
Destruction of dynamite	934
Detachment	283
caretaker	890-898
chief of	285, 295
Details, battle command	287, 289, 291, 317, 574
casemate	283, 563
chief of	285, 298
communication	283
company	283
company commander	289, 290
explosive	283
fire command	289, 291, 317
gun and mortar	283,
375, 391, 404, 405, 475-479, 505-508, 519, 520	
mine command	288, 290, 291, 600
powder	283, 375
projectile	283, 374
Detonators, commercial, care of	918-921
how supplied	917
inspection of	922
storage of	918-921
Deviation, absolute	97
at the target	96
definition	95
mean lateral	98
mean longitudinal	99
range	100
Device, obturating	55, 122, 170, 873
Devices, improvised	316
Diameter of bore	59
Differences, gun	127
range	206, 528
Directing gun	101
Directing lights	716
Directing point	101
Disappearing carriage	67

[Numbers refer to paragraphs.]

Dismissal of, batteries	312, 356
battle command	312
Dismounting breechlocks	682, 872
Displacement, definition	102
gun	128
District artillery engineer. (<i>See</i> Artillery engineer.)	
District, the artillery (<i>see</i> Artillery district)	Chapter XI, 19
how designated	20
District commander, appointment of rated enlisted men	292, 293
assignment of	580
assignment of companies by	278
assignment of officers by	274-277, 279-282
attendance at target practice	587
caretaker detachments	890-898
command when absent from district	582
control of water transportation	586
duties at drill and during hostilities	584-590
duties during encampment	588
duties in general	584-590
inspections	585
modifications he may allow	584
modifications in provisional installations	316
nature of command	583
night drill	590, 698, 699
rated enlisted men	1003
regulation of boat service	589
responsibility of	566, 584-590
service practice	643-658, 688
subcaliber practice	637
target practice	643-658, 688
working parties	595
District, headquarters	580, 581
ordnance officer. (<i>See</i> Ordnance officer.)	
Divisions of target practice	630, 632, 642
Double primary station, mine command, abbreviations and symbols	116
manning parties	560
Double secondary station, mine command, abbreviations and symbols	116
manning party	562
Drains and sumps	843
Drift	103
Drift corrections, gun battery, secondary armament	522
mortar (<i>see also</i> Mortar deflection board)	789
primary armament. (<i>See</i> Deflection board.)	
Drill, artillery, duties of artillery engineer	604
duties of battery commander	308,
312, 314-316, 319, 320-323, 354, 356, 480-	
487, 498-504, 509-512, 677, 678, 697, 698	
duties of battle commander	312, 567, 569, 576-579
duties of communication officer	546, 547
duties of district commander	584-590
duties of emplacement officer	307, 312, 324, 358, 372, 377
duties of fire commander	312, 543-545
duties of mine commander	312, 545, 556, 564
duties of range officer	312, 325, 498, 500, 502
duties of searchlight officer	571-573, 710
formation for	294-300
gun, 12-inch disappearing carriage	379-405
gun, 12-inch barbette carriage	428-434
gun, 10-inch disappearing carriage	408-411
gun, 10-inch barbette carriage	436
gun, 8-inch disappearing carriage	414, 415
gun, 8-inch barbette carriage	439
gun, 6-inch disappearing carriage	417, 419-424
gun, 6-inch pedestal mount	442, 445
gun, 5-inch, 4.7-inch, 4-inch	447, 448
gun, 3-inch	450, 452-457
gun, 6-pounder	460-473

[Numbers refer to paragraphs.]

modifications of -----	316, 543, 584
Drill, mortar, 12-inch -----	361-375
night -----	590, 696-699
primers -----	346
record of attendance -----	314
service at emplacement -----	Chapter VI
Dry gun cotton -----	964-968
Dummy ammunition -----	341, 394
Dynamite -----	923-934
decomposition of nitroglycerine in -----	933
destruction of -----	934
exposure to air -----	926
gloves for handling -----	928
inspections of -----	931-934
marking of packages -----	930
packing -----	923
principal source of danger -----	932
storage and care of -----	924-934
storage cases -----	927
temperature of freezing -----	925
E.	
Eight-inch gun battery. (<i>See</i> Gun battery, 8-inch.) -----	
Electrical installation, care of -----	889
Electrician, casemate. (<i>See</i> Casemate electrician.) -----	
Electrician sergeant, care of property -----	893
care of telautographs -----	741
duties -----	611, 613
supervision of -----	613
Electric motors for gun carriages -----	398
Elements of trajectory -----	254
Elevation, definition -----	104
quadrant -----	104, 201
setter -----	105, 361, 363
sight -----	104, 239
Eligibility for rated positions -----	999
Eligible list for rated positions -----	998-1001
Emergency -----	320, 323
Emergency practice, subcaliber -----	632, 634
Emergency station, abbreviation and symbols -----	116
manning party -----	478, 508
Emergency system, definition -----	189
gun battery, primary armament -----	502-504
indication and identification of targets -----	486
mortar battery -----	517
Emplacement, definition -----	106
inspection of -----	622, 625, 628
range keeper -----	479
service at -----	Chapter VI
Emplacement book -----	107
Emplacement officer, general duties -----	324
general duties at drill -----	307, 312, 324, 358, 372, 377
gun battery, 12-inch D. C. -----	376, 377
gun battery, 12-inch barbette carriage -----	425-428
gun battery, 10-inch D. C. -----	406
gun battery, 10-inch barbette carriage -----	435
gun battery, 8-inch D. C. -----	412
gun battery, 8-inch barbette carriage -----	438
gun battery, 6-inch D. C. -----	418
gun battery, 6-inch pedestal -----	442, 443
gun battery, 3-inch -----	450, 451
mortar battery -----	357, 358, 372
Empty metallic cases, care of -----	882
Encampment, duties of district commander -----	588
Energy of projectiles -----	108
Engineer, artillery. (<i>See</i> Artillery engineer.) -----	
Engineer Department -----	837, 838
Engineers -----	611, 614
Engineer property, minor defects -----	609
repairs of -----	593, 594, 602, 603

[Numbers refer to paragraphs.]

Enlisted personnel	283
Equalizing pipe	109
Errors, deflection, mortar batteries	512
Examination for rated positions	997-1004
Examination for gunners (<i>see also</i> Gunners' instruction)	Chapter XX
Exhibiting data for R. F. batteries	520, 521
Expendability of parts of armament	846
Explosives	Chapter XIX
Explosive "D"	935-946
barrels for	937-941, 945, 946
inspections	943-946
marking of barrels	937-941
packing of	935
storage and care of	936-942
Explosive detail	283
Explosives, black powder	911, 912
care of	Chapter XIX
commercial detonators	917-922
dynamite	923-934
explosive "D"	935-946
fuses and primers	198, 346-350, 352, 650-651, 882, 947-950, 965
general instructions	899-916
gun cotton	951-968
inspection	899
projectiles filled and fused	980-983
shipment of	886
storage cases for	900-905
Exterior crest	110
Exterior slope	111

F.

Faces of trunnions	263
Failure of apparatus	607
Failure of communications	498, 502
Field artillery	61
Field officers, assignment of	274
Field of fire, definition	112
safety of	636, 654
Field works	3
Fire, observation of	675-678
orders of	172, 544, 545
restricted	172, 220, 545, 578
unrestricted	172, 267, 545, 578
Fire and mine commands	Chapter IX
Fire area	113
Fire command practice. (<i>See</i> Target practice.)	
Fire command, definition and organization	15, 16
designation of	18
details	280, 291, 317
dismissal of	312
fire-control system	551-555
general	541-550
grouping of batteries	16
indication of a target	553-555
manning parties	286, 287, 289, 291, 548-552
manning table	286
night drill	697, 699
rated men	293
stations	116, 551, 552
target practice (service)	642-658, 683-685, 688
target practice (subcaliber)	632, 633, 635-637
Fire commander, action	579
assignment of	274, 276, 281, 645, 646
commands of	545
communication officer	546
duties of	541-546, 683
gunners' instruction, supervision of	584
independent action	543
instruction, manning parties	317

[Numbers refer to paragraphs.]

Fire commander, manning party	286, 287, 289, 291, 548-552
manning tables	286
modifications of regulations	543
nature of command	542
night drill	543, 697, 699
orders of fire	545
plotting board	791
records	543
reports to battle commander	309
responsibility of	541, 543, 654
rated men	293, 997, 1004
searchlight	711, 712
supervision of target practice	281, 543
target practice (service)	642-658, 683-685, 688
target practice (subcaliber)	632, 633, 635-637
Fire-control, the battery	Chapter VII
apparatus	Chapter XVII
definition	114
installation	114, 474
material	115
manning details for gun batteries, primary armament	475-479
manning details for gun batteries, secondary armament	519
manning details for mine stations	288, 290, 291
manning details for mortar batteries	505-508
manning details for other stations	600
methods for subcaliber practice	638
modifications	316, 543
personnel	115
range officer	209, 312, 325, 498, 500, 502
responsibility for apparatus	599-620
sections	283, 333
Fire-control station, abbreviations and symbols (<i>see also</i> Station)	116
care of	605, 610
construction and maintenance of	837
inspection of	623, 628
Fire-control system, battle command	576-579
definition	114
fire command	551-555
gun battery of the intermediate armament	518
gun battery of the primary armament	474-504
gun battery of the secondary armament	519-525
mine command	559-564
modifications of	316, 543, 584
mortar battery	505-517
Firemen	611, 615
Firing attachment, 12-inch gun, D. C.	387
Firing by electricity	651
Firing interval, definition	117
gun, 12-inch	401
mortar battery	514, 516
Firing mechanism	55, 352, 874-876
First-class gunners, examination of	984-996
instruction of	317, 984-996, 1000, 1003
First sergeant, formation for artillery drill	295-299
formation for infantry maneuvers	303
formation for roll calls	301, 302
Five-inch gun battery. (<i>See</i> Gun battery, 5-inch.)	
Fixed ammunition	70
Fixed lights	116, 118, 700, 707, 715, 717
Fixed targets for trial shots	668
Flags, at target practice	649
for signalling	725
Floating defenses	2
Focusing telescope	820
Forcing cone	50, 119
Formation, for artillery drill	294-304
for infantry maneuvers	303
for roll calls	301, 302

[Numbers refer to paragraphs.]

Formation, for marching maneuvers-----	304
of company-----	294-304
of sections-----	295, 296
Fort, artillery-----	77
Fortification power plants, load on-----	592
Fortifications-----	3, 4, 837
Four-inch gun battery. (<i>See</i> Gun battery, 4-inch.)	
Four-and-seven-tenths-inch gun battery. (<i>See</i> Gun battery, 4.7-inch.)	
From battery-----	120
Fuses and primers-----	947-950

G.

Gallery, definition-----	121
shot-----	235
Garlock packing-----	862
Garrison, coast artillery-----	78
Gas check-----	122
Gas-check seat, care of-----	680
General defense plans-----	123, 567-569
General instructions—the battery-----	337-356
General principles-----	Chapter I
Grooves-----	124, 221
Grouping of batteries in fire commands-----	16
Gun-arm center-----	784, 785
Gun battery, intermediate armament-----	5, 8, 10
fire-control system-----	518
Gun battery, primary armament, fire-control system-----	474-504
Gun battery, secondary armament, fire-control system-----	519-525
corrections-----	525, 676
Gun battery, 12-inch D. C., adjustment of indices-----	527
ammunition service-----	403-405
auxiliary horizontal base system-----	498, 499
bore sighting-----	526
breech detail-----	389
chief of ammunition service-----	403
close breech-----	382, 384
drill-----	379-405
emergency system-----	502-504
emplacement officer-----	376, 377
failure to go in battery-----	395
fire-control system-----	474-504
firing attachment-----	387
gun section-----	376
horizontal base system-----	487-497
indication and identification of targets-----	133, 137, 480-486
inspection after firing-----	682
load and fire-----	379, 385, 386, 391
manning details, fire control-----	475-479
method of pointing-----	532
notes on the drill-----	380-405
open breech-----	381, 383
organization of-----	376
pointing test-----	534-537
powder detail-----	405
projectile detail-----	404
rammer and truck detail-----	391
range differences-----	528
range setter-----	393, 400
retracting gun-----	402
shot trucks-----	392
time to load-----	401
tripping gun-----	390
vertical base system-----	500, 501
Gun battery, 12-inch, barbette carriage, adjustment of indices-----	527
ammunition service-----	434
auxiliary horizontal base system-----	498, 499
bore sighting-----	526
close breech-----	430

[Numbers refer to paragraphs.]

Gun battery, 12-inch, barbette carriage, drill	428-434
emergency system	502-504
emplacement officer	425-428
fire-control system	474-504
gun section	426
horizontal base system	487-497
indication and identification of targets	133, 137, 480-486
inspection after firing	682
lanyard	432
load and fire	431-433
manning details, fire control	475-479
method of pointing	532
notes on the drill	430-434
open breech	430
organization of	425-427
pointing test	534-537
ramming projectile	433
vertical base system	500, 501
Gun battery, 10-inch, D. C., adjustment of indices	527
ammunition service	409
auxiliary horizontal base system	498, 499
bore sighting	526
drill	408-411
emplacement officer	406
emergency system	502-504
failure to go in battery	395
fire-control system	474-504
gun section	407
horizontal base system	487-497
indication and identification of targets	133, 137, 480-486
inspection after firing	682
manning details fire control	475-479
method of pointing	532
notes on the drill	409-411
organization of	406, 407
pointing test	534-537
rammer and truck detail	391
range differences	528
shot trucks	392
tripping gun	390
vertical base system	500, 501
Gun battery, 10-inch, barbette carriage, adjustment of indices	527
ammunition service	437
auxiliary horizontal base system	498, 499
bore sighting	526
drill	436, 437
emergency system	502-504
emplacement officer	435
fire-control system	502-504
gun section	436
horizontal base system	487-497
indication and identification of targets	133, 137, 480-486
inspection after firing	682
manning details, fire control	475-479
method of pointing	532
notes on the drill	436
organization	435-437
pointing test	534-537
vertical base system	500, 501
Gun battery, 8-inch, D. C., adjustment of indices	527
ammunition service	414
auxiliary horizontal base system	498, 499
bore sighting	526
drill	414, 415
emplacement officer	412
emergency system	502-504
failure to go in battery	395
fire-control system	474-504
gun section	413

[Numbers refer to paragraphs.]

Gun battery, 8-inch, D. C., horizontal base system	487-497
indication and identification of targets	133, 137, 480-486
inspection after firing	682
manning details, fire control	475-479
method of pointing	532
notes on the drill	413
organization	412, 413
pointing test	534-537
rammer and truck detail	391
range differences	528
shot trucks	392
tripping gun	390
vertical base system	500, 501
Gun battery, 8-inch, barbette carriage, adjustment of indices	527
ammunition service	440
auxiliary horizontal base system	498, 499
bore sighting	526
drill	439, 440
emplacement officer	438
emergency system	502-504
fire-control system	474-504
gun section	439
horizontal base system	487-497
indication and identification of targets	133, 137, 480-486
inspection after firing	682
manning details, fire control	475-479
method of pointing	532
notes on the drill	439-440
organization	438, 440
pointing test	534-537
vertical base system	500, 501
Gun battery, 6-inch, D. C., adjustment of indices	527
ammunition service	422, 424
auxiliary horizontal base system	498, 499
bore sighting	526
drill	417, 419-424
emplacement officer	418
emergency system	502-504
gun section	418
fire-control system	474-504, 518
horizontal base system	487-497
indication and identification of targets	133, 137, 480-486
inspection after firing	682
load and fire	420
manning details, fire control	475-479
method of pointing	532
notes on drill	420, 424
organization of	416, 418
pointing test	534-537
range differences	528
retracting gun	421
time to load	423
vertical base system	500, 501
Gun battery, 6-inch, pedestal mount, ammunition service	444
auxiliary horizontal base system	498, 499, 523
bore sighting	526
drill	442, 445
emplacement officer	442, 443
emergency system	502-504
fire-control system	475-479, 518
gun section	443
horizontal base system	487-497
indication and identification of targets	133, 137, 480-486
inspection after firing	682
method of pointing	532
notes on the drill	442
organization of	441, 443, 444
pointing test	540
vertical base system	500, 501

[Numbers refer to paragraphs.]

Gun battery, 5-inch, 4.7-inch, 4-inch, ammunition service	447, 448
drill	447, 448
gun section	448
indication and identification of targets	133, 137, 523
inspection after firing	682
manning party, fire-control system	519, 520
method of pointing	532
notes on the drill	447, 448
organization	446
pointing test	540
range-finding system	521-525
Gun battery, 3-inch, ammunition service	453-455, 457
cartridges for	453-455
drill	450, 452-457
emplacement officer	450, 451
gun section	451
indications and identification of targets	133, 137, 523
inspection after firing	682
manning detail, fire-control system	519, 520
masking mount	67, 456, 457
method of pointing	532
notes on drill	453-457
organization	449, 451
pointing test	540
range-finding system	521-525
Gun battery, 6-pounder, American Ordnance Company model	473
ammunition service	463-467, 472
anchoring carriage	468
drill	460-473
gun section	459
indication and identification of a target	133, 137, 523
inspection after firing	682
load and fire	462, 463
notes on drill	462-473
organization	458, 459
serving table	472
Gun commander, at inspection	625
barbette guns	378, 395, 462, 464
battery, 6-pounder	462, 464
definition	125
disappearing guns	378, 395, 402
examination for, scope	1004
responsibility of	845
Gun company, definition	126
manning tables	286
sections, detachments, and details	283
Gun cotton, cases for	956-960
color of	955
inspections at posts	962, 963
inspections by Ordnance Department	961
packing	951
storage and care	952-960
Gun cotton, dry	964-968
handling of	967
primers	965
rewetting	968
storage of	966
use of	964
Gun detachments	283
Gun details	283
Gun differences	127
Gun displacement	128
Gun platform	129
Gun pointer, definition	130
barbette guns	429, 445, 452, 461, 468, 470, 471
battery of secondary armament	522
battery, 6-pounder	468, 470, 471
Case I	531
Case II	532
Case III	533

[Numbers refer to paragraphs.]

Gun pointer, disappearing guns	379, 408, 419, 537
examination for, scope	1004
indication and identification of a target	485
method of pointing	531-533
mortar battery	360, 361
pointing test	534-540
responsibility	335
target practice (service)	675
target practice (subcaliber)	639
Guns, automatic	156
care of	856-860, 888
care of breechblocks	872-876
definition	61
directing	101
habitual position of	860
machine	156
marking of	855
orientation of	527
painting of	851
paulins for	888
rapid fire	211
recoil cylinders	216, 849, 862, 869
semiautomatic	156
Gunners' instruction	984-996, 1000, 1003
attendance at	984
examination of	984-996, 1000, 1003
Guns and carriages, parts of, expenditure	846
Gun sections	283
12-inch, D. C.	376
12-inch, barbette	426
10-inch, D. C.	407
10-inch, barbette	436
8-inch, D. C.	413
8-inch, barbette	439
6-inch, D. C.	418
6-inch, pedestal	443
5-inch, 4.7-inch, 4-inch battery	448
3-inch	451
6-pounder	459
chief of	285, 295-298, 302, 307, 368
formation of	295, 296
posting	307, 308

H.

Habitual position, guns	860
mortars	368, 861
Handling of explosives	Chapter XIX
Headquarters, district	580, 581
post	287, 599-601
Heating of magazines	910
Heliograph	725
Hoist, ammunition, care of	835, 836
definition	22
powder	192
shot	236
Hoist room	131
Hoop	132
Horizontal base system, description	189
gun battery, primary armament	487-497
indication and identification of targets, gun battery, pri-	
mary armament	480-486, 509
indication and identification of targets, gun battery, sec-	
ondary armament	521, 523
mortar battery	510
Hostilities, duties of district commander	588
Howitzers	61

[Numbers refer to paragraphs.]

I.

Identification of a target, definition-----	133
gun battery, primary armament--	480-486, 509, 521, 523, 553-555
gun battery, secondary armament-----	521, 523
mortar battery-----	509
Illuminating searchlights-----	134, 700, 711, 712, 714
Improvised devices-----	316
In battery-----	135
In commission-----	136, 832-834
Independent action-----	319, 543
Indication and identification of a target, primary armament--	133,
secondary armament-----	137, 480-486, 509, 553-555, 576, 577
Indication of a target, battle command-----	576, 577
definition-----	137
fire command-----	521, 553-555
Indicator, traversing-----	258
wind component (<i>see</i> Wind component indicator)---	270, 824-828
Indoor instruction-----	317, 984-987
Infantry maneuvers-----	303, 304
Information booth, manning detail-----	520
Inner defense zone-----	271
In service-----	138, 832
Inspection, after firing-----	682
artillery (<i>see</i> Artillery inspection)-----	Chapter XIII
artillery engineer-----	591
battery commander-----	318, 624, 627
detonators-----	922
district commander-----	585
drains and sumps-----	843
dynamite in storage-----	931-934
explosive "D"-----	943-946
explosives-----	899
firing mechanism-----	352
fuses and primers-----	950
gun cotton-----	961-963
loaded projectiles-----	983
mortar pits-----	362, 626, 628
of the battery-----	621-628
order of-----	622
ordnance officer-----	597
smokeless powder-----	973-979
the battery-----	621-628
Installation, changes in-----	316, 543, 584, 592
electric, care of-----	889
fire control-----	114, 474
Instruction, detail for battle commander's stations-----	317
gunner's (<i>see</i> Gunner's instruction)-----	984-996, 1000, 1003
indoor-----	317, 984-987
method of-----	337-353
observers-----	329
Instructions, magazine-----	916
preliminary to target practice-----	647, 648, 658, 667, 684, 685, 885
Interior crest-----	139
Interior slope-----	140
Interior wall-----	141
Intermediate armament (<i>see</i> Gun Battery, intermediate arma- ment)-----	5, 8, 10
Interstate commerce law on shipment of explosives-----	886
Interval, firing-----	117, 401, 514, 516
observing-----	168

J.

Jacket-----	142
Jump-----	143

K.

Keys of magazines-----	906
------------------------	-----

[Numbers refer to paragraphs.]

L.

Land attacks	1, 80
Land front	145
Lands	144, 221
Lanyard, for 12-inch gun, barbette carriage	432
mortars	372
Lateral deviation	95, 98
Law on shipment of explosives, interstate commerce	886
Laying	146
Leaf range scale, the	764
Lewis D. P. F., adjustment of	774-779
Limited fire carriage	67
Litmus-paper test	975-978
Line of departure	147
Line of direction	148
Line of impact	149
Line of shot	150
Line of sight	151
Load and fire, 12-inch gun, disappearing carriage	379, 385, 386, 391
12-inch gun, barbette carriage	431-433
6-inch gun, disappearing carriage	420
6-pounder gun	462, 463
Loading, density of	93
Loading detachments	283
Loading platform	152
Loading position	153, 368
Loading projectiles	881
Loading tray	154
Load on fortification power plants	592
Location of a target	155
Longitudinal deviation	95, 99
Loose explosives	914
Lye, use of	854

M.

Machine guns	156
Machinery, care of	611
Main bore	50
Main chamber	190
Maintenance of apparatus	609
Maintenance of batteries	837
Maintenance of communications	602
Maintenance of searchlights	602
Maintenance of searchlight stations	610
Magazines, circulation of air	909
definition	157
for loaded projectiles	980
heating of	910
instructions	916
keys of	906
lights in	913
storage of gun cotton	952-960
temperature of	662, 910, 971
Manning details, gun battery, primary armament	475-479
gun battery, secondary armament	519, 520
mortar battery	505-508
Manning of a battle command	311
Manning parties, battle command	575
battle commander's and fire commander's station	310, 575
emplacement, fire control	479
fire command	286, 287, 289, 291, 548-552
mine command	288, 290, 291, 559-563
searchlights	703-706
Manning table	159, 286
Manual of the piece, gun battery, 12-inch, disappearing carriage	379-405
gun battery, 12-inch, barbette carriage	428-434
gun battery, 10-inch, disappearing carriage	408-411

[Numbers refer to paragraphs.]

Manual of the piece, gun battery 10-inch, harbette carriage	436, 437
gun battery, 8-inch, disappearing carriage	414, 415
gun battery, 8-inch, harbette carriage	439, 440
gun battery, 6-inch, disappearing carriage	417, 419-424
gun battery, 6-inch, pedestal	442, 445
gun battery, 5-inch, 4.7-inch, 4-inch	447, 448
gun battery, 3-inch	450, 452-457
gun battery, 6-pounder	460-473
mortar battery	361-375
Marching maneuvers	Chapter IV
Markers, range board	805
Marking, barrels for explosive "D"	937-941
dynamite packages	930
guns, mortars, and mortar pits	855
Masking mount	67
Masking mount, 3-inch gun	67, 456, 457
Master electrician	611, 612
Master gunner	611, 616
Material, care of	Chapter XVIII
damage to	844
fire control	115
for repair	115
Mean lateral deviation	98
Mean longitudinal deviation	99
Mechanics	336
at formation for artillery drill	296
Medical examination for rated positions	1002
Message, meteorological	160, 619, 670
Metallic cases, empty, care of	882
Meteorological message	160, 619, 670
Meteorological observations, trial shots	670
Meteorological observer	617-619, 670
Meteorological station	116, 610, 617-619
Method of fire control, mine command	564
Methods, improvised	316
Methods of pointing	531-533
Military preparations for defense of coast line	3
Militia	79
Mine cable. (See Cable.)	
Mine command, assignment of officers	279
casemates, manning party	563
designation of	17, 18
details	288, 290, 291
dismissal of	312
double primary station	560
double secondary station	562
fire-control system	559-564
manning parties	288, 290, 291, 559-563
manning tables	286
method of fire control	564
property officer	558
searchlights	572, 713, 714
stations	116, 559-563
target practice, subcaliber	632, 635
Mine commander, gunner's instruction	984
rated men	292, 1003
reports to battle commander	310
responsibility of	556, 557
target practice	281
Mine companies, definition	162
manning tables	286
organization of	283, 284
Mine field	163
Mine searchlights	572, 713, 714
Mines, submarine	161
Mine stations, details for	288, 290, 291, 600
Misfires	650, 651
mortar battery	360

[Numbers refer to paragraphs.]	
Mobile army	3
Modifications in fire control and drill	316, 543
Modifications in target practice regulations	688
Mortar, adjustment of index	529
adjustment of quadrants	530
care of	856-859, 861-868, 870-873
close breech	370
counter-recoil springs	864-869
definition	61
drift correction	789
drill	361-375
fire	371, 372
habitual position of	861
lanyard	372
manual for	361-375
marking of	855
method of pointing	533
open breech	369
orientation of	529
painting of	851
plotting board	788-790
use of	7
Mortar battery, ammunition service	373-375
auxiliary horizontal base system	517
azimuth setter	38, 361-363
chief of ammunition service	373
close breech	370
cover post	87, 363-367
deflection errors	512
dismissal of	359
drill	361-375
elevation setter	105, 361-363
emergency system	517
emplacement officer	357, 358, 372
fire-control manning details	505-508
fire-control system	505-517
firing interval	514, 516
firing of	372
gun pointer	360, 361
horizontal base system	510
indication and identification of targets	509
inspection of	362, 621-628
loading position	153, 368
mistres	360
notes on the drill	362-375
observing station	507
open breech	369
organization of	357
pit commander	125, 179, 334, 359, 626
pointing test	538
posting section	359
posts for inspection	362, 367
posts of cannoneers	362-367
powder detail	283, 375
predicting and firing	511-516
projectile detail	283, 374
service of piece	361-375
service of powder	365
vertical base system	517
Mortar companies, definition	164
manning tables	286
organization of	283
Mortar deflection board, description of	780
theory and use of	781, 789
Mortar detachments	283
Mortar details	283
Mortar pits, inspection of	362, 626, 628
marking of	855
Motors, gun carriage	398
Motor starter	835

[Numbers refer to paragraphs.]

Mount (<i>see</i> Carriage)	64
Mountain battery	61
Multiplying scale	768
Musicians at formation for artillery drill	296
Muzzle, definition	165
swell of	244
Muzzle velocity, definition	166
powder chart	792-795
probable, for trial shots	814, 815
subcaliber	633
weight of charge	796

N.

Name plates	852
Naming of batteries	14
Naval attack	1, 2, 3
Night drill, attendance at	699
battery	697, 698
battle command	697, 699
designation of	590
fire command	697, 699
object of	696, 697
tug	698, 699
Nitroglycerine, decomposition of	933
Normal use of searchlight	717
Notes on the drill, gun, 12-inch, D. C.	380-405
gun, 12-inch, barbette carriage	430-434
gun, 10-inch, D. C.	409-411
gun, 10-inch, barbette carriage	436
gun, 8-inch, D. C.	415
gun, 8-inch, barbette carriage	439-440
gun, 6-inch, D. C.	420-424
gun, 6-inch, pedestal mount	442
gun, 5-inch, 4.7-inch, and 4-inch	447, 448
gun, 3-inch	453-457
gun, 6-pounder	462-473
mortar battery	362-375

O.

Observation of fire	675-678
Observers, battery commander	323
definition	167
examination for	1004
horizontal base system	487
indication and identification of a target	480-486
instruction of	329
meteorological	617-619
selection of	326, 327
test of	330
tide	620
Observing interval	168
Observing room	116
Observing stations, definition	169
detachments for	283
gun battery, primary armament	477
mortar battery, manning detail	507
Obturator primers	350
Obturator	55, 122, 170, 873
Occult	171
Officers, assignment of	274-277, 279-282
at formation for roll calls	301
side arms at drill	300
Oil holes	862
Oils	839, 842, 848
Open breech, gun, 12-inch, 1888 mechanism	381
gun, 12-inch, barbette carriage	430
gun, 12-inch, 1895 mechanism	383
mortars	369

[Numbers refer to paragraphs.]	
Open sight.....	238
Operation of aerospace.....	751
anemometer.....	752
atmosphere board.....	750
azimuth instrument.....	755
deflection board.....	766-768
D. P. F.....	773, 779
mortar deflection board.....	781
plotting board, fire commander.....	791
powder chart.....	794, 795
range board.....	808-815
searchlights.....	790-724
telautograph.....	741-748
telephone.....	728-740
telescope.....	820
wind component indicator.....	828
Operators, searchlight.....	702-710, 721-724
telautograph.....	741-748
telephone.....	728-740
telephone, searchlight.....	702, 706
Order of inspection.....	622
Orders of fire.....	172, 544, 545
Orders relating to target practice.....	629, 658
Ordnance Department, pamphlets and publications.....	847
supplies and their use.....	839, 840
Ordnance machinist.....	594, 595, 597
Ordnance material, pamphlets concerning.....	847
Ordnance officers, accountability.....	597
inspections.....	597
repair shops.....	597
requisitions.....	597
responsibility.....	597, 833
Ordnance repair shops.....	597
Ordnance sergeant.....	892
care of property.....	892, 894
Organization.....	Chapter III
gun battery, 12-inch, D. C.....	376
gun battery, 12-inch, barbette carriage.....	425, 427
gun battery, 10-inch, D. C.....	406, 407
gun battery, 10-inch, barbette carriage.....	435-437
gun battery, 8-inch, D. C.....	412, 413
gun battery, 8-inch, barbette carriage.....	438, 440
gun battery, 6-inch, D. C.....	416, 418
gun battery, 6-inch, pedestal.....	441, 443, 444
gun battery, 5-inch, 4.7-inch, 4-inch.....	446
gun battery, 3-inch.....	449, 451
gun battery, 6-pounder.....	458, 459
mortar battery.....	357
Orientation and bore sighting.....	Chapter VIII
Orientation, azimuth instruments.....	754
definition.....	173
guns.....	527
mortars.....	529
plotting boards.....	782-785
table.....	174
Outer defense zone.....	271
Out of commission.....	832-834
Out of service.....	832

P.

Package, dynamite.....	923
explosive "D".....	935
fuses and primers.....	947
gun cotton.....	951
smokeless powder.....	969
Packing boxes, for projectiles.....	879
Packing, Garlock.....	862
Packing stuffing boxes.....	871
Pad, adjustment of.....	873

[Numbers refer to paragraphs.]

Painting	850-855
barrels for Explosive "D"	946
carriages	852
guns and mortars	851
marking guns, mortars, and pits	855
name plates	852
projectiles	880
Paints	838-840, 842
allowance of	850
preparation of	850, 853
removal from counter recoil springs	868
removal from guns and carriages	854
Pamphlets, Ordnance Department	847
Parade, battery	46
Parade slope	176
Parapet, care of	843
definition	177
Paulins	888
Permanent fortifications	3, 4
Permanent installations, modifications of	316
Personnel, artillery district headquarters	581
fire control	115
Piling projectiles	878
Pinch bars	395
Pipe, equalizing	109
Pit	178
Pit commander	125, 179, 334, 359
at inspections	626
Pit, mortar, marking of	855
Pit section	283
Plane of departure	180
Plane of direction	181
Plane of sight	182
Plan, general defense	123, 567-569
Planting and loading sections, divisions of	283
Planting detachments	283
Platen	758
Platen scale	758, 759
Platform, care of	843
gun	129
loading	152
truck	261
Plotter, auxiliary horizontal base system	499
definition	183
examination for	1004
horizontal base system	480
indication and identification of a target	481
mortar battery	511, 513
responsibility of	332
vertical base system	500
Plotting board, adjustment	782-785
definition	184
description of	782
detachment	283
detail	283
F. C.	791
mortars	788-790
numbering	786
orientation	782-785
subcaliber	787, 790
subcaliber, mortar	790
Plotting room, damage to	503
definition	185
gun battery, primary armament, manning detail	476
mortar battery, manning detail	506
Point, directing	101
Pointing	21, 68, 186, 531-533
method of	21, 68, 186, 531-533

[Numbers refer to paragraphs.]

Pointing test, gun battery primary armament	534-537
mortar battery	538
rapid-fire batteries	540
records of	536, 539
Point of fall	187
Point of impact	188
Police, buildings and grounds	890, 891, 894
Position finder. (<i>See</i> Depression position finder.)	
Position finding system	189
Position of guns, habitual	860
Position of mortars, habitual	368, 861
Post artillery engineer. (<i>See</i> Artillery engineer.)	
Post commander	281, 598-601
care of armament	599
details made by	287, 599-601
efficiency of personnel	599
manning tables	286
nature of command	598, 599
responsibility of	556, 599
Post headquarters, detail of manning parties	287
Posting sections	307, 308, 359
Post manning tables	286
Post ordnance officer. (<i>See</i> Ordnance officer.)	
Posts, cover	87, 363-367
Posts, mortar battery, at inspection	362, 367
Post telephone switchboard	116
Post, the	Chapter XII
Powder, blending	49, 885
care of	885, 911, 912, 970-979
delivery of for target practice	656, 673, 674
inspection of	973-979
lots to be used	663, 664
package, smokeless	969
poor practice due to	663
report of	665
sample bottles	975-978
samples of	974
service of	365, 396, 656, 673, 674
shipment of	886
storage and care of	885, 970-979
storage cases	972
storage of	661, 662, 885
target practice	661-665, 673, 885
temperature of magazines	662, 910, 971
test, litmus	975-978
Powder chamber	50, 190
Powder charges, delivery at target practice	656, 673, 674
handling, 12-inch battery	396
weights of	796
Powder charts, construction of	793
description of	792, 793
examples of use	795
object of	792
use of	794, 795
Powder chute	191
Powder detail	283
12-inch gun, D. C.	405
mortar battery	375
Powder hoist	192
Powder hoist well	193
Power detachment	283
Power plants, access to	608
batteries	608
care of	605
construction and maintenance of	837
duties of engineers	614
duties of firemen	615
duties of master electricians	612
increase of load	592

[Numbers refer to paragraphs.]

Power plants, inspections of	628
repairs to	592-594
Power sections, organization of	283
Practice. (<i>See</i> Target practice.)	
Precautions for safety, battery practice	647-658
battle command practice	687
fire command practice	684, 685
primers	352
salutes	693-695
Predicted point	194-196, 371
Predicted time	195
Predictor	196
Predicting and firing, mortar batteries	511-516
Predicting interval	194
Preliminary practice, subcaliber	632, 633
Preparation of paints	850, 853
Preparations for inspection	621
Preparations for target practice	658, 667, 885
Pressure gauges	671, 672
Primary armament (<i>see also</i> Gun battery, primary armament)	6, 10
Primary stations, abbreviation and definition	39, 116, 197
fire command manning party	551
mine command manning party	559
Primers, care of	882, 948, 949
combination	352
definition	198
drill	346
guncotton	965
insertion of	347
inspection of	950
obturator	350
package	947
precaution in case of failure	350
service	347-349
target practice	650, 651
Priming charges	199
Probable muzzle velocity	814, 815
Projectile detail, gun, 12-inch, D. C.	283, 404
mortar battery	374
Projectiles, care of	877-881, 980-982
delivery of, for target practice	673, 674
dummy	394
energy of	108
filled and fused	980-983
inspection of	983
loading of	881
packing boxes for	879
painting of	880
piling of	878
preparation for target practice	666
removal from gun	653
storage of	980-982
target practice	653, 666, 673, 877
travel of	255
Property officer, mine command	558
Property returns	846
Provisional installation modifications	316

Q.

Quadrant, adjustment of	530
definition	200
Quadrant elevation	104, 201
Qualification, as gunner, continuance of	1000
of rated enlisted men (<i>see</i> Rated enlisted men)	997-1004
Quartermaster Department, supplies	842

[Numbers refer to paragraphs.]

R.

Raiding parties	3
Rammer detail, gun battery, 12-inch	391
Ramming projectiles, gun, 12-inch, barbette carriage	433
Ramp	202
Range, corrected	83
corrections	525, 678
danger	89
definition	203
deviations	100
differences	206, 528
searchlight	229
Range azimuth table	204
Range board, adjustment of, boards issued December 26, 1906, and subsequently	813
boards issued prior to December 26, 1906	812
corrections	678
correction scale	801
curves	802, 803
definition	205
general description	798-807
markers	805
nomenclature	797
operation	808-815
probable muzzle velocity from	814, 815
reference numbers	804
ruler	800
travel ruler	806, 807
Range corrections, target practice	678
Range finder (<i>see</i> Depression position finder)	94
definition	207
Range-finding station, manning details, secondary armament (<i>see also</i> Fire-control station)	519, 520
Range-finding system, battery of secondary armament	520-525
Range keeper	208
Range officer	209
duties at drill	312, 325, 498, 500,
inspection	502
Range scale, calibration	60
Range setter, definition	210
gun battery, 12-inch	393, 400
Rapid-fire batteries, manning details	519, 520
mine command	17
pointing tests	540
range-finding system	520-525
Rapid-fire gun	211
Rapid-fire gun carriage	67
Rated enlisted men, appointment of	292, 293, 1003
battle command	293
continuance of qualification as gunner	1000
eligible for examination	999
eligible list	998-1001
examinations of	997-1004
medical examination	1002
qualification of	997-1004
scope of examination	1004
Rated positions, scope of examination	1004
Reader	331
Ready	212, 358
Rear slope	213
Receiving table	214
Recess, ammunition	23
breech	56
truck	262
Recoil	215
Recoil cylinders, care of	849, 862
cleaning	869
definition	216

[Numbers refer to paragraphs.]

Record, attendance at artillery drill	314
pointing tests	536, 539
Record practice, emergency conditions (subcaliber) (<i>see also</i>)	
Target practice, subcaliber	632
normal conditions (subcaliber)	632
Records, artillery engineer	607
of fire commander, target practice	683
Reference numbers	90, 217, 804
Regulations, for target practice, modifications in	688
of boat service	589
Relay	218
Relocation	155
Removal of paint from counter recoil springs	868
Removal of primers	650
Repairs, engineer property	593, 594, 602
minor defects	609
to power plants	592-594
Reports, artillery engineer	607
defects in material	682, 689, 844
during drill, practice or action	322
powder	665
target practice	682, 689, 690
Requisitions by ordnance officer	597
Reserve ammunition	315
Reserve detail	283
Reserves, coast artillery	78, 79
Reserve table	219
Responsibility, artillery engineer	605, 609, 610
battery commander	315, 609, 636, 655, 833
battle commander	566, 567, 654
district commander	566, 584-590
field of fire	636, 654, 657
fire commander	541, 543, 654
gun commander	845
mine commander	556, 557
ordnance officer	597, 833
post commander	556, 599
tactical, definition	246
Restricted fire	172, 220, 545, 578
Retraction of gun	402, 421
ropes	402
Rifling	221, 266
Rimbase	222
Roll calls	297
formation for	301, 302
Round	223
Roving light	224, 700, 707-710, 715, 717
Ruler, range board	800
Rules for using telautographs	748
telephones	739, 740

S.

Safety, field of fire	636, 654
Safety officer	684
Salutes	691-695
precautions for safety	693-695
Saluting interval	692
Salvo	225
Salvo point	226, 545
Salvo table	227
Sample bottles, powder	975-978
Samples of powder	974
Scope of examination, for gunners	994-996
for rated positions	1004
Searching with lights	710-714
Searchlight, battle command	572, 714
care of	723
carbons for	724
classification of	700

[Numbers refer to paragraphs.]

Searchlight, commands	720, 721
control of	720
definition	118, 134, 224
designation	718
directing	716
fixed	116, 118, 700, 707, 715, 717
illuminating	134, 700, 711, 712, 714
indication of a target	577
maintenance of	602
manning parties for	703-706
mine	572, 713, 714
normal use of	717
roving	224, 700, 707-710, 715, 717
searching	710-712
sectors	709
service of the lights	700-724
standard	701
telephone operators for	702, 706
two lights working together	716
vessels, thrown on	719
watcher	706, 710
Searchlight area	228
Searchlight officer	274, 571-573, 702, 710, 720
duties at drill	571-573, 710
Searchlight operator	702-710, 721-724
Searchlight, range	229
Searchlight station, abbreviation	116
maintenance	610
manning parties	703-706
Secondary armament (<i>see also</i> Gun battery, secondary arma- ment)	5, 9, 10
abbreviation	116
Secondary station, abbreviation	116
battery manning party	475-479, 505-508, 519
definition	39, 230
fire command manning party	552
mine command manning party	561, 562
Second-class gunners. (<i>See</i> Gunner.)	
Section, ammunition	283
Sections, chief of	285, 295-298, 302, 307, 308
formations of	295, 296
gun	376, 407, 413, 418, 426, 436, 439, 443, 448, 451, 459
posting	307, 308, 359
Sector, searchlight	709
Selection of observers	326, 327
of telephone operators	728-732
Semi-automatic guns	156
Service at the emplacement	Chapter VI
Service of ammunition, gun battery, 12-inch, disappearing car- riage	403-405
gun battery, 12-inch, barbette carriage	434
gun battery, 10-inch, disappearing carriage	409
gun battery, 10-inch, barbette carriage	437
gun battery, 8-inch, disappearing carriage	414
gun battery, 8-inch, barbette carriage	440
gun battery, 6-inch, disappearing carriage	424
gun battery, 6-inch, pedestal mount	444
gun battery, 5-inch, 4.7-inch, 4-inch	447, 448
gun battery, 3-inch	453-455, 457
gun battery, 6-pounder	463-467, 472
mortar battery	373-375
Service of the piece, general instructions	337-353
gun battery, 12-inch, disappearing carriage	376-405
gun battery, 12-inch, barbette carriage	425-434
gun battery, 10-inch, disappearing carriage	406-411
gun battery, 10-inch, barbette carriage	435-437
gun battery, 8-inch, disappearing carriage	412-415
gun battery, 8-inch, barbette carriage	438-440
gun battery, 6-inch, disappearing carriage	416-424
gun battery, 6-inch pedestal mount	441-445

[Numbers refer to paragraphs.]

Service of the piece, gun battery, 5-inch, 4.7-inch, 4-inch	446-448
gun battery, 3-inch	449-457
gun battery, 6-pounder	458-473
mortar battery	357-375
Service of powder	365, 396, 656, 673, 674
Service of searchlights	700-724
Service of telautographs	741-748
Service of telephones	728-740
Service practice. (<i>See</i> Target practice.)	
Service primers	347-349
Serving table, definition	231
for 6-pounder battery	472
Set forward point	196, 232
Shell, use of	6
Shell room	233
Shell tracers	234
Shipment of explosives	886
Shot, use of	6
Shot gallery	235
Shot hoists	236
Shot hoist well	237
Shot trucks	392
Shots, trial. (<i>See</i> Trial shots.)	
Side arms, at drill	300
Siege artillery	61
Sight elevation	104, 239
Sights, definition	238
open	238
telescopic	238, 249, 821
Signaling, visual	602, 649, 725
Signal property, care of	893
Signals, at target practice	649
for service of piece	353
Signal station	116, 610, 727
supplies	841
Six-inch gun battery, disappearing carriage. (<i>See</i> Gun battery, 6-inch, disappearing carriage.)	
Six-inch gun battery, pedestal mount. (<i>See</i> Gun battery, 6-inch, pedestal mount.)	
Six-pounder battery. (<i>See</i> Gun battery, 6-pounder.)	
Slope	25
Slope, blast	48
Slope, centering	50, 190
Slope, exterior	111
Slope, interior	140
Slope, parade	176
Slope, rear	213
Slope, superior	242
Smokeless powder (<i>see</i> Powder)	969-979
Speaking tube	725
Sponging, salutes	694
target practice	652
Springs, assembling of	867
cleaning and painting of	869
counter-recoil, preservation of	864-866
removal of paint from	868
Staff officers, assignment of	274
Stand fast	345
Standard searchlight	701
Starting motor	835
Station, base-end	39, 116
battery commander	44, 116, 321, 354, 605
double primary	116, 560
double secondary	116, 562
fire-control, abbreviations	116
fire-control, care of	610
inspection of	623, 628
meteorological	116, 610, 617-619
observing	116, 169
primary	39, 116, 197

[Numbers refer to paragraphs.]

Station, range finding. (<i>See</i> Fire-control station.)	
searchlight	116, 610
secondary	39, 116, 230
signal	116, 610, 727
supplementary	39, 116, 243
tactical command	272
tide	116, 610, 620
wireless	116, 610
Storage and care of dynamite	924-934
Storage and care of explosive "D"	936-942
Storage and care of fuses and primers	948, 949
Storage and care of gun cotton	952-960, 966
Storage and care of smokeless powder	970-977
Storage batteries, care of	611
Storage cases, cartridge	883, 884
for explosives	900-905
for smokeless powder	972
Storage of black powder	911, 912
Storage of detonators	918, 919
Storage of dry gun cotton	966
Storage of explosives	Chapter XIX
Storage of powder	661, 662, 885
Storage of projectiles	980-982
Striking angle	240
Striking velocity	241
Stuffing boxes, removal of packing from	870
repacking of	871
Subcaliber ammunition. (<i>See</i> Ammunition.)	
Subcaliber deflection board	765
Subcaliber gun, adjustment of	633
Subcaliber practice. (<i>See</i> Target practice, subcaliber.)	
Subcaliber practice plotting board	787
Subcaliber practice plotting board, mortar	788, 790
Subdivisions, remote stations, dismissal of	313
Submarine defenses	4
Submarine mines	161
Superior slope	242
Supervision of electrician sergeants	613
Supervision of target practice	281, 543
Supplementary stations	39, 116, 243
Supplies, Engineer Department	838
Ordnance Department	839, 840
quartermaster	842
signal	841
Supports, coast artillery	3, 19, 78, 80
Swasey, D. P. F., adjustment of	770-773
Swell of the muzzle	244
Switchboard, post telephone	116
Symbols and abbreviations, fire-control stations	116

T.

Table, delivery	92
Table, manning	159, 286
Table, orientation	174
Table, range, azimuth	204
Table, receiving	214
Table, reserve	219
Table, salvo	227
Table, serving	231
Tactical chain, units of	12
Tactical command	245
Tactical command, stations for	272
Tactical responsibility	246
Take cover	344
Targ.	247
Target, definition	248
for trial shots	668
identification of	133, 480-486, 509, 521, 523, 553-555

[Numbers refer to paragraphs.]

Target, indication of	137, 480-486, 509, 521, 523, 553-555, 576, 577
location of	155
relocation of	155
travel of	256
Target practice	Chapter XIV
Target practice (service), ammunition service	674
arbitrary deflection correction	675
attendance at	587
battery commander, safety officer	684
battery	642-682, 689, 690
battle command	642, 644, 647-658, 686, 687, 688
breechblocks	673, 679, 680, 682
cease firing	653
cleaning of bore and chamber	681
commence firing	673
delivery of powder charges	656, 673, 674
district commander	643, 658, 688
divisions of	630, 642
fire command	642-650, 683-685
firing by electricity	651
flags and signals	649
gas check	680
gun pointer	675
inspection after firing	682
mine commander	281
misfires	650, 651
modification of practice regulations	688
observation of fire	675-678
orders relating to	629, 658
powder	661-665, 673, 885
precautions for safety	647-658, 684, 685, 687
preparations for	658-667, 885
pressure gauges	671, 672
projectiles for	653, 666, 673, 877
range corrections	678
records of fire commander	683
removal of primers	650
removal of projectiles	653
reports	682, 689, 690
responsibility for field of fire	636, 654, 657
sponging	652
supervision of	281, 543
time of	643
trial shots	667-672, 814, 815
Target practice (subcaliber), at home stations	641
battery	632-635
battle command	632, 635, 638
deflection	765
deflection board	765
determination of muzzle velocity	633
district commander	637
divisions of	632
emergency	632, 634
gun pointer	639
methods of fire control	638
normal condition	632
object of	631
preliminary	632, 633
record	632
responsibility, field of fire	636
time of	637
where held	640
Telautograph, care of	741, 889
service of	741-748
Telephone operators, selection of	728-732
test of	729, 730
training of	735
Telephone operators for searchlights	702, 706

[Numbers refer to paragraphs.]

Telephones, care of	735-738
test of	733, 734
Telephone service	728-740
Telephone switchboard	116
Telescope	819, 820
adjustment of	820
care of	819, 887
focusing of	820
repair of	887
Telescopic sight	238, 249, 821
Temperature of magazine	662, 910, 971
Ten-inch gun battery. (See Gun battery, 10-inch.)	
Test, ammunition service	628
cable	596, 606
communications and mine cables	596, 605, 606, 734
litmus paper	975, 978
new devices and methods	316, 543
observers	330
telephone operators	729, 730
telephones	733, 734
Thermometers	617, 822
Three-inch gun battery. (See Gun battery, 3-inch.)	
Throttling bar	250
Tide observer	620
Tide station	116, 610, 620
Time interval bell	251, 497
Time interval system	497, 823
Time of target practice	637, 643
Time range board	252, 393
Time to load, gun battery, 12-inch, disappearing carriage	401
gun battery, 6-inch, disappearing carriage	423
Tracer, shell	234
Tracking	253
Training of telephone operators	735
Trajectory	254
Travel of projectile	255
Travel of target	256
Travel ruler	806, 807
Traverse	257
Traversing by electricity	399, 400
Traversing indicator	258
Trial shots, meteorological observations	670
object of	259, 525, 669
pressure gauges	671
probable muzzle velocity	667-672, 814, 815
targets for	668
Training and examination of candidates for gunners and special ratings	Chapter XX
Tripping	390, 395
Trolley	260
Truck, detail, gun battery	391
platform	261
recess	262
shot	392
without brakes	397
Trunnion band	264
Trunnions	263
T-square scale	763
Tube	265
Tug	586
Twelve-inch gun battery. (See Gun battery, 12-inch.)	
Twist of rifling	266
Typical battle command	273

U.

Units of tactical chain	12
Unrestricted fire	172, 267, 545, 578

[Numbers refer to paragraphs.]

V.

Vane, wind	829
Velocity, muzzle. (<i>See</i> Muzzle velocity.)	
striking	241
wind	617, 618
Vent	268, 681
Vertical base system, gun battery, primary armament	500, 501
indication and identification of a target by	482
mortar battery	517
Visual signaling	602, 649, 725

W.

Walk, battery commander's	45
Wall, corridor	85
Wall, interior	141
War Department, authority for modifications in permanent installation	316
Washing bores	681, 682
Watchers, searchlight	706, 710
Water front	269
Water transportation	586
Weights of powder charges	796
Well, counterweight	86
powder hoist	193
shot hoist	237
Wheeled carriage	67
Wind, azimuth and velocity of	617, 618
Wind arc, the	762
Wind component indicator, definition	270
object and description of	824-827
operation of	828
Wind corrections, gun battery, secondary armament	522
Wind vane	829
Wireless communication	725
Wireless stations	116, 610
Working parties	595

Z.

Zone	271
------	-----

O

